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To the READER.

Courteous Reader,

I HAVING had the Happineſs of an intimate Acquaintance with Mr. *Cocker* in his Life-time, often ſolicited him to remember his Promiſe to the World, of Publiſhing his *Arithmetick*; but (for Reaſons beſt known to himſelf) he refus'd it; and (after his Death) the Copy falling accidentally into my Hands, I thought it not convenient to ſmother a Work of ſo conſiderable a Moment, not queſtioning but it might be as kindly accepted, as if it had been preſented by his own Hand. The Method is familiar and eaſy, diſcovering as well the Theorick as the Practick of that Neceſſary Art of *Vulgar Arithmetick*: And in this new Edition there are many remarkable Alterations for the Benefit of the Teacher or Learner, which I hope will be very acceptable to the World: I have alſo performed my Promiſe in publiſhing the *Decimal Arithmetick*, which finds Encouragement to my Expectation, and the Bookſellers too. I am

Thine to ſerve thee,

JOHN HAWKINS

Mr. *Edward Cocker*'s

PROEME or PREFACE.

BY the ſacred Influence of Divine Providence, I have been inſtrumental to the Benefit of many by Vertue of thoſe uſeful Arts, Writing *and* Engraving: *And do now with the ſame wonted Alacrity, caſt this my Arithmetical Mite into the publick Treaſury, beſeeching the Almighty to grant the like Bleſſing to theſe as to my former Labours.*

Seven Sciences ſupremely excellent,
Are the chief Stars in *Wiſdom*'s Firmament:
Whereof *Arithmetick* is one, whoſe Worth
The Beams of Profits and Delights ſhine forth;
This crowns the reſt, This makes Man's Mind compleat;
This treats of Numbers, and of This we treat.

I have been often deſired, by my intimate Friends, to publiſh ſomething on this Subject; who, in a pleaſing Freedom, have ſignified to me, That they expected it would be extraordinary. How far I have anſwer'd their Expectation,

pectation, I know not; but this I know, That I have deſigned this Work not extraordinary abſtruſe or profound; but have, by all Means poſſible within the Circumference of my Capacity, endeavoured to render it extraordinary uſeful to all thoſe, whoſe Occaſions ſhall induce them to make uſe of Numbers. *If it be objected, That the Books already publiſhed, treating of* Numbers, *are innumerable; I anſwer, That's but a ſmall Wonder, ſince the Art is infinite. But that there ſhould be ſo many excellent Tracts of* Practical Arithmetick *extant, and little practis'd, is to me a great Wonder; knowing that as* Merchandize *is the Life of the Weal-publick, ſo* Practical Arithmetick *is the Soul of* Merchandize. *Therefore I do ingenuouſly profeſs, That in the Beginning of this Undertaking, the numerous Concerns of the honoured Merchant firſt poſſeſſeth my Conſideration: And how far I have accommodated this Compoſure for his moſt worthy Service, let his own profitable Experience be judge.*

Secondly, *For your Service, moſt excellent Profeſſors, whoſe Underſtandings ſoar to the Sublimity of the Theory and Practice of this Noble Science, was this Arithmetical Tractate*

Compoſed ; which you may pleaſe to employ as Monitor to inſtruct your young Tyroes, *and hereby take Occaſion to reſerve your precious Moments, which might be exhauſted that Way, for your more important Affairs.*

Thirdly, *For you, the ingenious Off-ſpring f happy Parents, who will willingy pay the ull Price of Induſtry and Exerciſe for thoſe Arts and choice Accompliſhments, which may ontribute to the Felicity of your future State : For you, I ſay, (ingenious Practitiners) was this Work compoſed, which may rove the Pleaſure of your Youth, and the Glory of your Age.*

Laſtly, *For you, the pretended Numeriſts f this Vapouring Age, who are more diſingeiouſly Witty to propound unneceſſary Queſtins, than ingenuouſly Judicious to reſolve uch as are neceſſary ; for you was this Book ompoſed and publiſhed, if you will deny our ſelves ſo much as not to invert the Streams of your Ingenuity, but by ſtudiouſly onferring with the Notes, Names, Orders, Progreſs, Species, Properties, Proprieties, Proportions, Powers, Affections and Appliations of* Numbers *delivered herein, become uch Artiſts indeed, as you now only ſeem to be.*

be. *This* Arithmetick *ingenuouſly obſerved, and diligently practiſed, will turn to good Account to all that ſhall be concerned in Accompts; ſince all its Rules are grounded on Verity, and delivered with Sincerity; the Examples built up gradually from the ſmalleſt Conſideration to the greateſt; and all the Problems, or Propoſitions, well weighed, pertinent, and clear, and not one of them throughout the Tract taken upon Truſt; therefore now,*

Zoilus and *Momus*, lie you down and die,
For theſe Inventions your whole force defie.

Edward Cocker.

Courteous Reader,

B*EING well acquainted with the deceaſed Author, and finding him knowing and ſtudious in the Myſteries of* Numbers, *and* Algebra, *of which he had ſome choice Manuſcripts, and a great Collection of printed Authors in ſeveral Languages, I doubt not but he hath writ his* Arithmetick *ſuitable to his own* Preface, *and worthy Acceptation; which I thought fit to certify on a Requeſt to that Purpoſe made to him that wiſheth thy Welfare, and the Progreſs of Arts.*

John Collens.

November 27. 1677.

* * *

***This Manual of* Arithmetick *is recommended to the World by Us whoſe Names are ſubſcribed*, viz.**

Mr. John Collens
Mr. James Atkinſon
Mr. Peter Perkins
} *Matth.*
Mr. Rich. Lawrence, *Sen.*
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Mr. John Hawkins

And generally approved by all Ingenious Artiſts.

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CHAP.

CHAP. I.

Notation of Numbers.

*A*Rithmetick is an Art of Numbering or Knowledge, which teacheth to Number well. And there are divers Species and Kinds of *Arithmetick* and *Geometry*, the which we do intend to treat of in order; applying the Principles of the one to the efinition of the other. For as Greatneſs is the Sub- eƈt of *Geometry*, ſo Number is the Subjeƈt of *Arithme- ick*; and if ſo, then their firſt Principles and chief undamentals, muſt have like Definitions; or at leaſt ome Congruency.

2. Number is that, by which the Quantity of any ing is expreſs'd or numbred; as the Unit is the umber by which the Quantity of the Thing is ex- eſs'd or ſaid to be one, and two by which it is nam'd vo, and ½ half, by which it is nam'd or call'd half, d the Root of 3 by which it is called the Root of 3; e like of any other.

5. Hence it is that Unit is Number; for the Part of the ſame Matter that is his whole, the Unit is t of the Multitude of Units, therefore the Unit is the ſame Matter that is the Multitude of Units; t the Matter of the Multitude of Units is Number, refore the Matter of Unit is Number; for elſe if n a Number given no Number be ſubtracted, the mber given remaineth; as ſuppoſe 3 the gi[illegible], if as e ſuppoſe, 1 be no Number, then if you ſubtract 1 n 3, there muſt remain 3 ſtill; which is very ab-

. Hence it will be convenient to examine from ence Number hath its Riſe or Beginning. Moſt Authors maintain, That Unit is the Beginning of *Number*, and it ſelf no Number; but looking upon the Principles and Definitions in the firſt Rudiments of Geometry, we ſhall find that the Definition of a Point is in no way congruous with the Definition of an Unit in Arithmetick; and therefore One or Unit muſt be in the Bounds or Limits of Number, and conſequently the Beginning of Number is not to be found in the Number One; wherefore we make Number and Magnitude congruent in Principles, and like in Definitions, we make and conſtitute a Cypher to be the Beginning of Number, or rather the Medium between increaſing and decreaſing Numbers, commonly called abſolute or whole Numbers, and negative or fractional Numbers, between which nothing can be imagin'd more agreeable to the Definition of a Point in Geometry; for as a Point is an Adjunct of a Line, and it ſelf no Line, ſo is a (0) Cypher an Adjunct of Number, ahd itſelf no Number: And as a Point in Geometry cannot be divided or increas'd into Parts: So likewiſe (0) cannot be divided or increas'd into Parts: For, as many Points, tho' in Number infinite, do make no Line, ſo many (0) Cyphers, though in Number infinite, do make no Number. For the Line A B cannot be increas'd by the Addition of the Point C, neither can the Number D be increaſed by the Addition of the (0) Cypher E, for if you add Nothing to 6, the Sum will be 6, (0) Cypher neither increaſing nor diminiſhing the Number 6; but if it be granted that A B be extended or prolonged to the Point C. ſo that A C be made a continu'd Line, then A B is increas'd by the Addition of the Point C. In like manner if we grant D (6) be prolong'd to E (0) ſo that D E (60) be a continu'd Number, making 60, then 6 is augmented by the Aid of (0) as the conſtituting the Number (60) Sixty; and furthermore that One or Unit is material

A———— B
C
D 6
E 0
—
Sum 6

A——B——C

D E } 60
6 6

material and a Number, and that (0) is the Beginning of Number, is prov'd by all Authors, altho' directly; for the Tables of Sines and Tangents prove one Degree to be a Number, becauſe the Sine of 1 Degree is 174524 (the Radius being 10000000) and the Beginning of that Table is (0) and it anſwereth 00000, *&c.*

5. Hence it is that Number is not Quantity diſcontinu'd, for all that which is but one Quantity, is not Quantity disjunct, (60) ſixty as it is a number, is one Quantity, *viz.* one Number (60) ſixty; therefore as it is Number, it is not Quantity disjunct; for Number is ſome ſuch Thing in Magnitude, as Humidity in Water; for as Humidity extends itſelf thro' all and every part of Water, ſo Number related to Magnitude, doth extend itſelf through all and every Part of Magnitude. Alſo, as continu'd Water doth anſwer continu'd Humidity, ſo to a continu'd Magnitude doth anſwer a continued Number. As the continued Humidity of any intire Water, ſuffereth the ſame Diviſion and Diſtinction that his Water doth; ſo the continued Number ſuffereth the ſame Diviſion and Diſtinction that his Magnitude doth. And thus much concerning the Definition and Principles of Number and Magnitude; we come now to treat of

6. The Characters or Notes by which Numbers are ſignify'd, or by which a Number is ordinarily expreſs'd; and they are theſe, *viz.* (0) Cypher or Nothing, 1 One, 2 Two, 3 Three, 4 Four, 5 Five, 6 Six, 7 Seven, 8 Eight, 9 Nine. The Cypher, which though of itſelf it expreſſeth not any certain or known Quantity, yet is the Beginning or Root of Number, and the other nine Figures are call'd ſignificant Figures or Digits.

7. In *Numbers* of any ſort, two Things are to be conſider'd, *viz. Notation* and *Numeration.*

8. *Notation* teacheth how to deſcribe any *Number* by certain Notes and Characters, and to declare the Value thereof being ſo deſcrib'd, and that is by Degrees and Periods.

9. A Degree conſiſts of three Figures, *viz.* of three Places, comprehending Units, Tens, and Hundreds; ſo

365 is a Degree, and the firſt Figure (5) on the right Hand, ſtands ſimply for his own Value, being Units, or ſo many Ones, *viz.* Five; the ſecond in order from the Right, ſignifies as many times Ten, as there are Units contained in it, *viz.* ſixty; the third in the ſame order ſignifies ſo many Hundreds as it contains Units, ſo will the expreſſion of the Number be Three hundred ſixty five, *&c.*

10. A Period is when a Number conſiſts of more than three Figures or places, and whoſe proper Order is to prick every third place, beginning at the Right Hand, and ſo on to the Left; ſo the Number 63452 being given, it will be diſtinguiſhed thus, 63.452, and expreſſed thus, Sixty three thouſand, four hundred fifty two; likewiſe 4.578.236.782 being diſtinguiſhed as you ſee, will be expreſs'd thus: Four thouſand, five hundred ſeventy eight Millions, two hundred thirty ſix thouſand, ſeven hundred eighty two.

11. *Number* is either Abſolute or Negative.

12. Abſolute, or Intire, Whole, Increaſing Number, is that which by annexing another Figure or Cypher, it becomes ten times as much as it ſtood for before; and if two Figures or Cyphers be annex'd, it makes an hundred times as much as it ſtood for before, *&c.* As if you annex to the Figure 6 a Cypher, then it will become (60) ſixty; ſo if two Cyphers are annex'd, then it will be (600) ſix hundred, and if you do annex to it a (4) four, then it will be (64) ſixty four; and if you annex (78) ſeventy eight, it will be then (678) ſix hundred ſeventy eight, *&c.*

13. A Negative, or Broken Fractional, Decreaſing Number, is that which by prefixing a point or prick towards the Left hand, its Value is decreaſed from ſo many Units, to ſo many tenth parts of any Thing, and if a Point and (0) Cypher, or Digit, be prefixed, it will be then ſo many hundred parts; and if a Point and two Cyphers or Digits be prefixed, its Value is decreaſed to be ſo many thouſandth parts, as if you would prefix before the Figure 3 a Point (.) or prick thus, (.3)

it is then decreaſed from 3 Units or 3 Integers, to three tenth parts of an Unit or Integer: And if you prefix an Unit and Cypher thus (.03) it is decreaſed from 3 Integers to 3 hundred parts of an Integer, and by this means 5 *l.* abſolute, by prefixing of a point, will be decreaſed to 55 *l.* negative, which is 5 tenth parts of a pound, equal in value to ten Shillings; and ſo by prefixing of more Cyphers or Digits, its Value is decreaſed in a decuple proportion *ad infinitum.* As in the following Scheme, or rather Order of Numbers, we have placed (o) Cypher in its due Place and Order, as it is in the Beginning and Medium of Number; foregoing from (o) towards the Left hand, you deal with intire, abſolute, whole, increaſing Numbers.

Increaſing Numbers. *Decreaſing Numbers.*

29	876	543	256	21012	345	678	976	3
mm	mmm	mmm	mmm	CXUXC	mmm	mmm	mmm	m
mm	mmm	mmm	CX		XC	mmm	mmm	m
mm	mmm	CX				XC	mmm	m
mm	mmm						XCX	
X	CX							

But going from (o) the place of Units towards the Right hand, you meet with broken, negative Fractions, and decreaſing Numbers. And hence it follows, that Multiplication increaſeth the Product in abſolute Numbers, but decreaſeth the Product in negative Numbers. Alſo Diviſion decreaſeth the Quotient in Whole Numbers, and increaſeth it in negative fractional Numbers.

14. An abſolute, intire, whole, increaſing Number, hath always a Point annexed towards the Right hand; and therefore,

15. A negative, broken, decimal, decreaſing Number, hath always a point prefixed before it towards the Left hand. When we expreſs Integers or whole Numbers, as 5 *Pounds*, 5 *Feet*, 26 *Feet*, we uſually annex a
l. Feet. Men. Inch.
point or prick after the Number thus, 5, 5, .26, 347. But when we expreſs Decimals, or Numbers that are

denied to be entire,as decreaſing Numbers, we do commonly prefix a point or prick before the ſaid Decimal or decreaſing Number thus (.3) that is three tenths, or 3 primes ; (.03) that is three hundredths, or 3 ſeconds.

16. A whole or abſolute Number is an Unit, or a compoſed Multitude of Units, and it is either a prime or elſe a compound Number.

17. Prime Numbers amongſt themſelves, are thoſe which have no Multitude of Units for a common Meaſurer, as 8 and 7, or 10 and 13, becauſe not any Multitude of Units can equally meaſure or divide them without a Remainder.

18. Compound Numbers amongſt themſelves, are thoſe which have a Multitude of Units for a common Meaſurer, as 9 and 12, becauſe 3 meaſures them exactly, and abbreviates them to three and four.

19. A broken Number, commonly called a Fraction, is a part or parts of a whole Number, *viz.* a part of an Integer, as $\frac{1}{3}$ one third, is one third part of an Unit.

20. A broken Number or Fraction, conſiſts of 2 parts, *viz.* the Numerator and the Denominator.

21. The Numerator and Denominator of a Fraction, are ſet one over the other, with a Line between them: and the Numerator is ſet above the Line,and expreſſeth the parts therein contained.

22. The Denominator of a Fraction, is the inferior *Number* placed below the Line,and expreſſeth the Number of parts into which the Unit or Integer is divided ; as let $\frac{3}{4}$ be the Fraction given, ſo ſhall 3 be the *Numerator*, and doth expreſs or number the Multitude of Parts contained in this *Fraction*, for $\frac{3}{4}$ is a Fraction compounded of Fourths or Quarters ; and the Figure 3 in numbering ſhews us, that in that Fraction there are Three of thoſe Fourth Parts or Quarters ; alſo in the ſame *Fraction* $\frac{3}{4}$, 4 is the *Denominator*, and doth expreſs the Quality of the Fraction, *viz.* that the whole or Integer is here divided into 4 equal parts.

23. A *Broken Number*, is either Proper or Improper, *viz.* proper when the *Numerator* is leſs than the *Denominator*, for $\frac{3}{4}$ is a perfect *proper Fraction*, but an *impro-*

per Fraction hath its *Numerator* greater, or at leaſt equal to the *Denominator*, thus $\frac{13}{8}$ is an *improper Fraction*, the Reaſon is given in the Definition.

24. A proper *Broken Number*, is either *Simple* or *Compound*, viz. *Simple*, when it hath one Denomination, and *Compound*, when it conſiſteth of divers Denominations. If $\frac{3}{4}$ $\frac{6}{12}$ $\frac{25}{100}$, were given, we ſay, they are each of them *Single* or *Simple Fractions*, becauſe they conſiſt but of one *Numerator*, and one *Denominator*; but if $\frac{3}{4}$ of $\frac{2}{12}$ of $\frac{35}{100}$ of a Pound *Sterling* were given, we ſay, that is a *Compound Broken Number* or *Fraction*, becauſe the Expreſſion and Repreſentation conſiſteth of more Denominations than one; and ſuch by ſome are called *Fractions of Fractions*; they have always this Particle (of) between them.

25. When a ſingle *broken Number* or *Fraction* hath for his *Denominator* a *Number* conſiſting of an Unit in the firſt Place toward the left hand, and nothing but Cyphers from the Unit toward the Right Hand, it is then the more aptly and rightly called a *Decimal Fraction*, under this Head are all our Decreaſing *Numbers* placed, and in our 13th Definition, called *Negatives*, and by that Order there preſcribed, we order them to be *Decimals*, by ſigning a prick or point before them, or the *Numerator*, rejecting the *Denominator*: Therefore according to our laſt Rule, $\frac{5}{10}$ $\frac{5}{100}$ $\frac{25}{1000}$, are ſaid to be *Decimals*; and a *Decimal Fraction* may be expreſſed without its *Denomator* (as before) by prefixing a point or prick before the *Numerator* of the ſaid *Fraction*, and then ſhall the former *Fractions* 25 $\frac{5}{10}$ and $\frac{25}{1000}$ ſtand thus, .5, 05. and .025.

But oftentimes as in the ſecond and *fourth Fraction* $\frac{5}{100}$ and $\frac{52}{1000}$, a prick or point will not do without the Help of a Cypher or Cyphers prefixed before the ſignificant Figures of the *Numerator*, and therefore when the *Numerator* of a *Decimal Fraction* conſiſteth not of ſo many places as the *Denominator* hath Cyphers, fill up the void places of the *Numerator*, with prefixing Cyphers before the ſignificant Figures of the *Numerator*, and then ſign it for a *Decimal*, ſo ſhall $\frac{5}{100}$ be .05

and $\frac{35}{1000}$ will be .05, and $\frac{72}{10000}$ will be .0072. Now by this we may eaſily diſcover the *Denominator* having the *Numerator*; for always the *Denominator* of any *Decimal Fraction* conſiſts of ſo many Cyphers, as the *Numerator* hath places, with an Unit prefixed before the ſaid Cypher, *viz.* under the point or prick.

26. A *Decimal Number* or *Fraction*, is expreſſed by *Primes*, *Seconds*, *Thirds*, *Fourths*, &c. and is Number decreaſing. Here inſtead of *Natural* and *Common Fractions*, as $\frac{3}{4}$ of a Thing, we order the Thing or Integer into *Primes*, *Seconds*, *Thirds*, *Fourths*, *Fifths*, &c. that our Expreſſion may be conſonant to our former Order.

27. In *Decimal Arithmetick* we always imagine that all intire Units, Integers and Things are divided firſt into ten equal parts, and theſe parts ſo divided we call *Primes*; and ſecondly, we divide alſo each of the former *Primes* into other ten equal parts, and every of theſe Diviſions we call *Seconds*; and thirdly, we divide each of the ſaid *Seconds* into ten other equal parts, and thoſe ſo divided, we call *Thirds*; and ſo by decimating the former, and ſub decimating theſe latter, we run on *ad infinitum*.

28. Let a Pound *Sterling*, *Troy-weight*, *Averdupois-weight*, *Liquid Meaſure*, *Dry Meaſure*, *Long Meaſure*, *Time*, *Dozen*, or any other Thing, or Integer be given to be *decimally* divided: In this Notion premiſed we ought to let the firſt Diviſion be *Primes*, the next Diviſion *Seconds*, the next *Thirds*, &c. So one pound *Sterling* being 20 Shillings, which divided into ten equal parts, the value of each part will be 2 Shillings; therefore, one *Prime* of a Pound *Sterling* will ſtand thus: (.1) which is in Value 2 Shillings; three *Primes* will ſtand thus; (.3) and that is in Value 6 Shillings. Again, a *Prime* or .1 being divided into ten equal parts, each of thoſe parts will be one *Second*, and is thus expreſs'd, (.01) and its Value will be found to be 2*d.* Farthing and $\frac{6}{10}$ of a Farthing; and ſo will .05 ſignifiy one Shilling, or have five *Seconds*. And if .01 be divided into ten other equal parts, each of thoſe parts ſo divided will be *Thirds*, and will ſtand thus, .001, and its value will be

found to be .96 of a Farthing, or $\frac{96}{100}$ of a Farthing, and .009 *Thirds* will be 2*d*. and 64 of a Farthing, or $\frac{64}{100}$ of a Farthing, &c. So that 375 *l.* will be found to repreſent 7*s*. 6*d*. for the three *Primes* are 6 Shillings, and the 7 *Seconds* are 1*s*. 4*d*. and $\frac{2}{10}$ of a Penny, and the 5 *Thirds* are 1 Penny, and $\frac{8}{10}$ of a Penny, both which added together make 7*s*. 6*d*.

29. If you put any Bulk or Body, repreſenting an Integer, if it be *decimally divided*, then the parts in the firſt Decimation are *Primes*, the next *Seconds*, and the next Decimation is *Thirds*, the next *Fourths*, &c. As let there be given a Bullet of Lead or ſuch like, whoſe Weight let it be 50 *l. Troy*, this call an Unit, Integer, or Thing; then will the like Weight and Matter make 10 other, the which together, will be equal to 50 *l.* and will weigh each of them 5 *l.* apiece; take of the ſame Matter, and equal to 5 *l.* make 10 more, then each of thoſe will weigh 6 Ounces apiece; alſo, if again you take 6 Ounces, and thereof make 10 other ſmall Bullets, each of them will weigh 12 Penny-weight *Troy*, and thus have you made *Primes, Seconds,* and *Thirds*, in reſpect of the Integer, containing 50 *l. Troy weight*; So that 5 *Primes* is equal to the half Maſs and 2 *Primes*, and 2 *Seconds* is a quarter of the Maſs; and therefore one of the firſt diviſion, 2 of the ſecond diviſion, and 5 of the third diviſion, will be equal in Weight to half a quarter of the Maſs, and contains 6 *l.* 3 Ounces.

30. When a *Decimal Fraction* followeth a *whole Number*, you are to ſeparate or part the *Decimal* from the *whole Number* by a point or prick; ſo if 75 followed the *whole Number* 32, ſet them thus, 32.75. You ſhall find that divers Authors have divers Ways in expreſſing *mixt Numbers*, as thus, 32|75, or 32|$\frac{75}{100}$, or 32|$\overset{\cdot\cdot}{7}\overset{\cdot\cdot}{5}$, but you will find that 32.75 thus placed and expreſſed, is the fitteſt for Calculation.

31. A *mixt Number* hath 2 parts; the whole, and the broken; the whole is that which is compoſed of Integers, and the broken is a *Fraction* annexed thereunto. So the *mixt Number* 36$\frac{8}{12}$ being given, we ſay, that 36 is the *whole Number*, which is compoſed of Integers; and

the $\frac{8}{12}$ is the *broken Number* annexed, which ſheweth that one of the former Integers (of that 36) being divided into 12 parts, $\frac{8}{12}$ doth expreſs 8 of thoſe 12 parts more, belonging to the ſaid 36 Integers.

32. *Denominative Numbers* are of one, or of many, and thoſe are of divers Sorts and Kinds, *viz. Singular*, called Unit, as 1; and *Plural*, called Multitude, as 2, 3, 4, 5; *Single*, of one Kind only called *Digits*, as 1, 2, 3, 4, 5, 6, 7, 8, 9; and Compounds of many, 10, 11, 12, *&c.* 102, 367, *&c.*

Proportional, as Single, Multiply, Double, Triple, Quadruple, *&c.* *Denominate*, as Pounds, Shillings, Pence; *Undenominate*, as 1, 2, 3, *&c.* *Perfect*, as 6, 28, 496, 8128, 130816, 2096128, *&c.* whoſe parts are equal to the Numbers; *Imperfect*, unequal, and more than the Sum, as 12, to 1, 2, 3, 4, 6; *Imperfect*, unequal, and leſs than the Sum, as 8, to 1, 2, 4. *Numbers* Commenſurable and Incommenſurable, as 12 and 9, are Commenſurable, becauſe 3 meaſures them both; but 6 and 17 are Incommenſurable, becauſe no one common *Number* or *Meaſure* can meaſure them; *Linear*, in form of a Line, as .... *Superficial*, in form of a Superficies or Plane, as : : : :, or ⋮ ⋮, *&c.* and Number cubical or ſolid in Form of a Cube. Theſe two latter are otherwiſe called figurative Numbers: There are alſo other Numbers called Tabular, as Sines, Tangents, Secants, *&c.* Others that be called Logarithmetick, or borrowed Numbers, fitted to Proportion for eaſe, and ſpeedy Calculation of all manner of Queſtions.

CHAP. II.

Of the Natural Diviſion of Integers, and the ſeveral Denominations of the Parts.

1. AND that we may advance Methodically herein, we will begin with the main Pillars on which Arithmetick is founded, *viz.* the ſeveral Species of that Art: But firſt,

Of

Of Money, Weights, &c.

2. The leaſt Denomination or Fraction of Money uſed in *England*, is a Farthing, from whence is produced the following Table, called the *Table of Coin*, viz.

1 *Farth.*	make	1 *Farthing*
4 *Farth.*	make	1 *Penny*
12 *Pence*	make	1 *Shilling*
20 *Shill.*	make	1 *Pound*

And therefore,

l.	*s.*	*d.*	*qrs.*
1	20	12	4
1	20	240	960
	1	12	48
		1	4

The firſt of theſe Tables, *viz.* that on the Left hand, is plain and eaſy to be underſtood, and therefore wants no Directions. In the ſecond Table above the Line you have 1*l.* 20*s.* 12*d.* 4 *qrs.* whereby is meant, That a Pound is equal to 20 Shillings, and 1 Shilling is equal to 12 Pence, and 1 Penny is equal to 4 Farthings; under the Line is 1*l.* 20*s.* 240*d.* 960 *qrs.* which ſignifies 1*l.* to contain 20 Shillings, or 240 Pence, or 960 Farthings; in the ſecond Line below that is 1*s.* 12*d.* 48 *qrs.* the firſt ſtanding under the Denominator of Shillings, whereby is to be noted, that 1 Shilling is equal to 12 Pence, or 48 Farthings; and likewiſe that below that, one Penny is equal in Value to four Farthings; underſtand the like Reaſon in all the following Tables of Weight, Meaſure, Time, Motion, and Dozen.

Of Troy weight.

3. The leaſt Fraction or Denomination of Weight uſed in *England*, is a Grain of Wheat gathered out of the middle of the Ear, and well dried; from whence are produced theſe following Tables of Weight, called *Troy Weight*.

32 *Grains of Wheat*	make	24 *Artificial Grains*
24 *Artificial Grains*	make	1 *Penny weight*
20 *Penny weight*	make	1 *Ounce*
12 *Ounces*	make	1 *Pound Troy weight.*

And therefore,

l.	*oun.*	*p. w.*	*grains*
1	12	20	24
1	12	240	5760
	1	20	480
		1	24

Troy weight ſerveth only to weigh Bread, Gold, Silver, and Electuaries; it alſo regulateth and preſcribeth a form how to keep the Money of *England* at a certain Standard.

Of Apothecaries Weights.

4. The *Apothecaries* have their Weights deduc'd from *Troy weight*, a Pound *Troy* being the greateſt Integer, a Table of whoſe Diviſion and Sub-diviſion followeth, *viz.*

1 *pound*	make	12 *ounces*
1 *ounce*	make	8 *drams*
1 *dram*	make	3 *ſcruples*
1 *ſcruple*	make	20 *grains*

And therefore,

l.	*oun.*	*drams*	*ſcrup.*	*gr.*
1	12	8	3	20
1	12	96	288	5760
	1	8	24	480
		1	3	60
			1	20

5. Thus much concerning *Troy weight*, and its derivative Weights; beſides which, there is another kind of Weight uſed in *England*, known by the Name of *Averdupois-weight* (1 Pound of which is equal to 14 Ounces 12 Penny-weight *Troy weight*) and it ſerveth to weigh all kinds of Grocery Wares, as alſo Butter, Cheeſe, Fleſh, Wax, Tallow, Roſin, Pitch, Lead, *&c.* the Table of which is as followeth.

A Table of Averdupois-weight.

4 *quarters of a dram*	make	1 *dram*
16 *drams*	make	1 *ounce*
16 *ounces*	make	1 *pound*
28 *pounds*	make	1 *quarter of a hundred*
4 *quarters*	make	1 *hundred weight at* 112 *l.*
20 *hundred*	make	1 *tun*

And therefore,

Tun	*C.*	*qr.*	*l.*	*oun.*	*drams*	*qrs.*
1	20	4	28	16	16	4
1	20	80	2240	35840	573440	2293760
	1	4	112	1792	28672	114688
		1	128	448	7168	28672
			1	16	256	1024
				1	16	64
					1	4

Wooll is weighed with this Weight, but only the diviſions are not the ſame.

A Table of the denominative Parts of Wooll-Weight.

7 *pounds*	make	1 *clove*
2 *cloves*		1 *ſtone*
2 *ſtones*		1 *todd*
6 *todd* 1 *ſtone*		1 *wey*
2 *weys*		1 *ſack*
12 *ſacks*		1 *laſt*

And therefore,

Laſt	*Sack*	*Wey*	*Todd*	*Stone*	*Cloves*	*l.*
1	12	2	$6\frac{1}{2}$	2	2	7
1	12	24	150	312	624	4368
	1	2	13	26	52	364
		1	$6\frac{1}{2}$	13	26	182
			1	2	4	28
				1	2	14
					1	7

Note, That in ſome Countries, the *Wey* is 256 *l.* *Averdupois*, as in the *Suffolk Wey*; but in *Eſſex* there is 336 *l.* in a Wey.

6. The leaſt denominative part of *Liquid Meaſure* is a Pint, which was formerly taken from *Troy weight*, (1 Pound of Wheat *Troy weight* making a Pint of *Liquid Meaſure*) but ſince, by a late Act of Parliament, to prevent Frauds in the Exciſe, the Pint Beer Meaſure is to contain $35\frac{1}{4}$ ſolid Inches, and the Wine Pint $28\frac{7}{8}$ the like Inches, *&c.*

A Table of Liquid Meaſure.

35¼ *cubical inches*	make	1 *pint Beer meaſure*
28⅞ *cubical inches*		1 *pint Wine meaſure*
2 *pints*		1 *quart*
2 *quarts*		1 *pottle*
2 *pottles*		1 *gallon*
8 *gallons*		1 *firk. of ale, ſoap or beer*
9 *gallons*		1 *firkin of beer*
10 *gallons and a half*		1 *firkin of Salmon or Eels*
2 *firkins*		1 *kilderkin*
2 *kilderkins*		1 *barrel*
42 *gallons*		1 *tierce of wine*
63 *gallons*		1 *hogſhead*
2 *hogſheads*		1 *pipe or butt*
2 *pipes or butts*		1 *tun of wine*

And therefore,

tun	*pipes*	*hhds*	*gall.*	*pints*
1	2	2	63	8
1	2	4	252	2016
	1	2	126	1008
		1	63	504
			1	8
				1

7. The leaſt denominative part of Dry Meaſure is alſo a Pint, and this is likewiſe taken from *Troy weight*.

A Table of Dry Meaſure.

2 *pound Troy*	make	1 *pint*
2 *pints*		1 *quart*
2 *quarts*		1 *pottle*
2 *pottles*		1 *gallon*
5 *gallons*		1 *peck*
4 *pecks*		1 *buſhel*
2 *buſhels*		1 *comb*
2 *combs*		1 *quarter*
2 *quarters*		1 *chaldron*
5 *quarters*		1 *wey*
3 *weys*		1 *laſt*

And therefore,

laſt	*wey*	*qrs.*	*com.*	*buſh.*	*pecks*	*gall.*	*pints*
1	2	5	2	4	4	2	8
1	2	10	20	80	320	640	5120
	1	5	10	40	160	320	2560
		1	2	8	32	64	512
			1	4	16	32	256
				1	4	8	64
					1	2	16
						1	8

8. The leaſt denominative part of *Long Meaſure* is a Barly-Corn well dried and taken out of the middle of the Ear; whoſe Table of parts followeth.

3 *Barly-corns*	make	1 *inch*
12 *inches*		1 *foot*
3 *feet*		1 *yard*
3 *feet* 9 *inches, or a yard and a quarter*		1 *ell Engliſh*
6 *feet*		1 *fathom*
5 *yards and a half*		1 *pole, perch, or rod*
40 *poles or perches*		1 *furlong*
8 *furlongs*		1 *Engliſh mile*

And therefore,

mile	*furl.*	*poles*	*yards*	*feet*	*inches*	*barly-corns*
1	8	40	5½	3	12	3
1	8	320	1760	5280	63360	190080
	1	40	220	660	7920	23760
		1	5½	16½	198	594
			1	3	36	108
				1	12	36
					1	3

And note, that the Yard, as alſo the Ell, is uſually divided into 4 quarters, and each quarter into 4 Nails.

Note alſo that a Geometrical Pace is 5 Feet; and here are 1056 ſuch Paces in an *Engliſh* Mile.

9. The parts of the Superſicial Meaſures of Land are ſuch as are mentioned in the following Table, *viz.*

A Table of Land Meaſure.

40 *ſquare Poles or Perches*	make	1 *Rood, or quarter of an Acre*
4 *Roods*	make	1 *Acre*

By the foregoing *Table of Long Meaſure*, you are informed what a Pole or Perch is ; and by this that 40 ſquare Perches is a Rood. Now a ſquare Perch is a Superficies very aptly reſembled by a ſquare Trencher, every ſide thereof being a Perch of 5 yds and an half in length, 40 of them is a Rood, & 4 Roods an Acre. So that a Superficies that is 40 Perches long and 4 broad, is an Acre of Land, the Acre containing in all 160 ſquare Perches.

10. The leaſt denominative part of Time, is one *Minute*, the greateſt Integer being an *Year*, from whence is produced this

Table of Time.

1 *Minute*	make	1 *Minute*
60 *Minutes*	make	1 *Hour*
24 *Hours*	make	1 *Day Natural*
7 *Days*	make	1 *Week*
4 *Weeks*	make	1 *Month*
13 *Months*, 1 *Day*, 6 *Hours*	make	1 *Year*

But the Year is uſually divided into twelve unequal *Kalendar Months*, whoſe Names and the Number of Days they contain, are as follow, *viz.*

	Days
January	31
February	28
March	31
April	30
May	31
June	30
July	31
Auguſt	31
September	30
October	31
November	30
December	31

So that the Year containeth 365 Days, and 6 Hours ; but the 6 Hours are not reckoned but only every 4th Year, and then there is a Day added to the latter end of *February*, and then it containeth 29 Days ; and that Year is called Leap-Year, and containeth 366 Days.

And here *note*, That as the Hour is divided into 60 Minutes, ſo each Minute is ſub-divided into 60 Seconds, and each Second into 60 Thirds, and each Third into 60 Fourths, *&c.*

The Tropical Year, by the exacteſt Obſervation of the moſt accurate *Aſtronomers*, is found to be 365 Days, 5 Hours, 49 Minutes, 4 Seconds, and 21 Thirds.

CHAP. III.

Of the Species and Kinds of Arithmetick.

THERE are ſeveral Species of this Art; and which may be termed either Natural, Artificial, Analytical, Algebraical, Lineal, or Inſtrumental: But what we are now to treat upon, relates to the Single Parts of Natural Arithmetick ſo far as concerns Numeration, of which there are alſo four Kinds, viz. *Addition*, *Subtraction*, *Multiplication*, and *Diviſion*.

CHAP. IV.

Addition of Whole Numbers.

1. A*Ddition* is the Reduction of two or more *Numbers*, of like kind, together into one Sum or Total. Or it is by which divers Numbers are added together, to the end that the Sum or Total value of them all may be diſcovered.

The firſt Number in every *Addition* is called *Addible Number*; the other, the *Number* or *Numbers* added, and the *Number* invented by the *Addition* is called the *Aggregate* or *Sum* containing the Value of the *Addition*.

The Collation of the numbers, is the right placing the Number given reſpectively to each Denomination, and the Operation is the Artificial adding of the numbers given together in order to the finding out of the *Aggregate* or *Sum*.

2. In *Addition* place the Numbers given reſpectively the one above the other, in ſuch ſort, that the like degree, place or denomination, may ſtand in the ſame Series, *viz.* Units under Units, Tens under Tens, Hundreds under Hundreds, *&c.* Pounds under Pounds, Shillings under Shillings, Pence under Pence, *&c.* Yards under Yards, Feet under Feet, *&c.*

3. Having thus placed the numbers given (as before) and drawn a Line under them, add them together, beginning with the leſſer Denomination, *viz.* at the Right Hand; and ſo on, ſubſcribing the Sum under the Line reſpectively; as for Example,

Let there be given 3352, and 213, and 133, to be added together, I ſet the Units in each particular Number under each other, and ſo likewiſe the Tens under the Tens, *&c.* and draw a Line under them, as in the Margent; then I begin at the place of Units, and add them together upwards, ſaying, 3 and 3 are 6, and 2 make 8, which I ſet under the Line, and under the ſame Figures added together; then I proceed in the next place, being the place of Tens, and add them in the ſame manner as I did the place of Units, ſaying, 3 and 1 are 4, and 5 are 9, which I likewiſe ſet under the Line reſpectively; then I go to the place of Hundreds, and add them up as I did the other, ſaying, 1 and 2 are 3, and 3 are 6, which is alſo ſet under the Line; and laſtly, I go to the place of Thouſands, and becauſe there are no other Figures to add to the 3, I ſet it under the Line in its reſpective place, and ſo the Work is finiſhed; and I find the Sum of the 3 given Numbers to be 3698.

$$\begin{array}{r}3352\\213\\133\\\hline 3698\end{array}$$

4. But if the Sum of the Figures of any Series exceedeth Ten, or any number of Tens, ſubſcribe under the ſame the exceſs above the Ten, and for every Ten carry one to be added to the next Series towards the Left hand, and ſo go on till you have finiſhed your Addition; always remembring, that how great ſoever

the Sum of the Figures of the laſt Series is, it muſt all be ſet down under the Line reſpectively. So 3678 being given to be added to 2357, I ſet them down as is before directed, and as you ſee in the Margent, with a Line drawn under them, then I begin and add them together, ſaying, 7 and 8 are 15, which is 5 above 10, wherefore I ſet 5 under the Line, and carry one for the 10 to be added to the next Series, ſaying, 1 that I carry'd and 5 is 6, and 7 are 13, wherefore I ſet down 3 and carry 1 (for the Ten) to the next Series; then I ſay, 1 that I carry'd and 3 are 4, and 6 are 10, now becauſe it comes to juſt 10, and no more, I ſet 0 under the Line, and carry 1 for the 10 to the next, and ſay, 1 that I carried and 2 are 3, and 3 are 6, which I ſet down in its reſpective Place; thus the *Addition* is ended, and the total Sum of theſe Numbers is found to be 6035. Several Examples of this kind follow.

3678
2357
———
6035

Numbers to be added
354867
573846
785946
347205
———
Sum 2061864

Numbers to be added
748647
465834
76483
648400
———
Sum 1939264

Numbers to be added
45346
38074
8437
923
76
———
Sum 92856

5. If the Numbers given to be added, are contain'd under divers Denominations, as of *Pounds*, *Shillings*, *Pence*, and *Farthings*; or of *Tuns*, *Hundreds*, *Quarters*, *Pounds*, &c. Then in this Caſe having diſpoſed of the Numbers, each Denomination under other of the like Kind; beginning at the leaſt Denomination, (minding

ing how many of one Denomination do make an Integer in the next) and having added them up, for every Integer of the next greater Denomination that you find therein contained, bear an Unit in mind to be added to the ſaid next greater Denomination, expreſſing the Exceſs reſpectively under the Line, proceed in this manner until your *Addition* be finiſhed; the following Example will make the Rule plain to the Learner. Thus theſe following Sums being given to be added, *viz.* 136 *l.* 13 *s.* 4 *d.* 2 *qrs.* and 79 *l.* 07 *s.* 10 *d.* 3 *qrs.* and 33 *l.* 18 *s.* 09 *d.* 1 *qr.* alſo 15 *l.* 09 *s.* 05 *d.* 0 *qrs.* The Numbers being diſpoſed according to Order, will ſtand as in the Margent. Then I begin at the Denomination of Farthings, and add them up, ſaying, 1 and 3 are 4, and 2 makes 6. Now I conſider that 6 Farthings are 1 Penny and 2 Farthings, wherefore I ſet down the 2 Farthings in its place under the Line; and keep 1 in mind to be added to the next denomination of Pence: then I go on, ſaying, 1 that I carried and 5 are 6, and 9 are 15, and 10 are 25, and 4 are 29; now I conſider that 29 Pence are 2 Shillings and 5 Pence, therefore I ſet down 5 Pence in order under the Line, and keep 2 in mind for 2 Shillings to be added to the Shillings; then I go on ſaying, 2 that I carried and 9 are 11, and 18 are 29, and 7 are 35, and 13 are 49; then I conſider that 49 Shillings are 2 Pounds and 9 Shillings, wherefore I ſet the 9 Shillings under the Line, and carry the 2 for the 2 pounds to the next and laſt Denomination of pounds, and proceed, ſaying, 2 that I carried and 5 make 7, and 3 are 10, and 9 are 19, and 6 are 25; then I ſet down 5, and carry 2 for the 2 Tens; and proceed, ſaying, 2 that I carry and 1 is 3, and 3 are 6, and 7 are 13, and 3 make 16, and I ſet down 6, and carry 1 for the 10, and go on, ſaying, 1 that I carried and 1 are 2, which I ſet in its place under the Line, and the Work is finiſh'd; and thus I find

l.	*s.*	*d.*	*qrs.*
136—	13—	04—	2
79—	07—	10—	3
33—	18—	09—	1
15—	09—	05—	0
265—	09—	05—	2

find the Sum of the foreſaid Numbers to be 265 *l.* 9 *s.* 5 *d.* 2 *qrs.* There is another Example, in the Operation, of which the Learner muſt have an eye to the Table of *Troy weight.* The Numbers given are 38 *l.* 7 *oz.* 13 *p. w.* 18 *gr.* and 50 *l.* 10 *oz.* 10 *p.w.* 12 *gr.* and 42 *l.* 08 *oz.* 05 *p. w.* 16 *gr.* and in order to the Addition thereof I place them as you ſee, and proceed to Operation; ſaying, 16 and 12 are 28, and 18 are 46; now becauſe 24 Grains make 1 penny weight, 46 Grains are 1 penny-weight, and 22 Grains, wherefore I ſet down 22, and carry 1 for the penny-weight, and 5 makes 6, and 10 are 16, and 13 are 29, wdich is 1 Ounce and 9 penny weight. I ſet down 9 in its place under the Line, and carry 1 to the Ounces, ſaying, 1 that I carry and 8 are 9, and 10 are 19, and 7 are 26, and becauſe 26 Ounces make 2 pounds 2 Ounces, I ſet down 2 for the Ounces, and carry 2 to the pounds; going on, 2 that I carry and 2 are 4, and 8 make 12, that is 2 and go 1; then 1 I carry and 4 are 5, and 5 are 10, and 3 are 13, which I ſet down as in the Margent, and the Work is finiſhed, and I find the Sum of the ſaid Numbers to amount to 132 *l.* 2 *oz.* 9 *p. w.* 22 *gr.* The way of proving theſe, or any Sum in the Rule, is ſhewed immediately after the enſuing Examples.

l.	*oz.*	*p.w.*	*gr.*
38	07	13	18
50	10	10	12
42	08	05	16
132	02	09	22

Addition of Engliſh Money.

l.	s.	d.	qrs.
436	13	07	1
184	09	10	3
768	17	04	2
564	11	11	0
1954	12	09	2

l.	s.	d.	qrs.
48	15	11	1
76	10	07	3
18	00	05	3
24	19	09	2
168	06	10	1

Addition of Troy weight.

l.	oz.	p.w.	gr.
15	07	13	12
18	06	04	20
11	10	16	18
09	04	10	22
19	11	18	04
22	00	00	00
97	05	04	04

l.	oz.	p.w.	gr.
145	09	12	18
726	08	14	10
389	07	06	13
83	10	16	20
130	00	10	12
74	07	15	00
1550	08	16	61

Addition of Apothecaries Weights.

l.	oz.	dr.	ſc.	gr.
48	07	1	0	14
74	05	5	2	10
64	10	7	1	16
17	08	1	0	11
34	09	6	1	09
240	05	6	1	00

C.	oz.	dr.	ſc.	gr.
60	03	4	0	10
48	10	6	0	14
34	08	2	1	15
18	11	2	2	11
160	07	1	2	15
35	02	5	1	07
358	07	7	7	12

Addition of Averdupois Weight.

Tun.	C.	qrs.	l.
75	13	1	15
48	07	3	21
60	11	1	17
21	07	0	25
12	16	0	11
218	17	0	05

l.	oun.	dr.
36	10	12
22	11	13
11	07	04
15	04	10
20	00	09
106	03	00

Addition of Liquid Meaſure.

Tun	pipe	hhd.	gal.
45	1	1	48
15	0	1	17
38	0	0	47
1[illegible]	1	0	56
21	1	1	18
133	1	1	60

Tun	hhd	gal.	pts.
30	3	40	4
12	0	28	6
47	5	60	5
57	3	22	3
17	0	00	0
168	1	26	2

Addition of Dry Meaſure.

chald.	qrs.	buſh.	pec.
48	3	7	3
13	1	4	0
54	0	6	2
16	3	6	1
40	1	0	1
173	3	0	3

qrs.	buſh.	pec.	gall.
17	3	1	1
50	1	3	0
14	5	3	1
40	2	0	1
30	0	3	0
152	5	3	1

Addition of Long Meaſure.

yds.	qrs	nails
35	3	3
14	1	2
74	2	3
38	0	1
30	1	0
15	0	0
208	1	1

ells	qrs.	nails
56	1	3
13	3	2
48	2	1
50	1	0
74	0	2
17	1	0
260	0	0

Addition of Land Meaſure.

Acre	rood	perch
12	3	18
14	0	24
30	2	19
48	3	30
28	1	38
50	3	26
185	3	35

Acre	rood	perch
86	1	36
47	3	24
73	2	18
60	0	07
04	2	08
14	1	14
286	3	27

The Proof of Addition.

6. *Addition* is prov'd after this Manner: When you have found out the Sum of the Number given, then ſeparate the uppermoſt Line from the reſt with a ſtroke or daſh of the pen, and then add them all up again as you did before, leaving out the uppermoſt Line; and having ſo done, add the new invented Sum to the uppermoſt Lines you ſeparated, nnd if the Sum of thoſe two Lines be equal to the Sum firſt found out, then the Work was performed true, otherwiſe not. As for Example; Let us prove the firſt Example of *Addition of Money*, whoſe Sum we find to be 265 *l.* 9 *s.* 5 *d.* 2 *qrs.* and which we prove thus; Having ſeparated the uppermoſt Number from the reſt by a Line, as you ſee in the Margent, then I add the ſame together again, leaving out the ſaid uppermoſt Line, and the Sum thereof I ſet under the firſt Sum or true Sum, which doth amount to 128*l.* 16*s.* 1*d.* 0 *qrs.* then again I add this new Sum to the uppermoſt Line that before was ſeparated from the reſt, and the Sum of thoſe two is 265 *l.* 09 *s.* 5 *d.* 2 *qrs.* the ſame with the firſt Sum, and therefore I conclude that the Operation was rightly performed.

l.	*s.*	*d.*	*qrs*
135	13	04	2
79	07	10	3
34	18	09	1
15	09	05	0
265	09	05	2
128	16	01	0
265	09	05	2

7. The main End of *Addition* in Queſtions reſolvable thereby, is to know the Sum of ſeveral Debts, Parcels, Integers, *&c.* Some Queſtions may be theſe that follow.

Queſt. 8. There was an old Man whoſe Age was required; to which he reply'd, I have 7 Sons, each having two Years between the Birth of each other, and in the 44th Year of my Age my eldeſt Son was born, which is now the Age of the youngeſt. I demand, What was the old Man's Age?

Now to reſolve this Queſtion, firſt ſet down he Father's Age at the Birth of his firſt Child hich was 44, then the Difference between the ldeſt and the youngeſt, which is 12 Years, and en the Age of the youngeſt, which is 44, and en add them all together, and their Sum is oo, the compleat Age of their Father.

44
12
44
———
100

Queſt. 2. A man lent his Friend at ſeveral times, theſe veral Sums, *viz.* At one time 63 *l.* at another time *l.* at another time 48 *l.* at another time 156*l.* Now deſire to know how much was lent him in all?

Set the Sums lent, one under another, as you e in the Margent, and then add them together, d you will find their Sum to amount to 317 *l.* hich is the Total of all the ſeveral Sums lent, d ſo much is due to the Creditor.

63
50
48
156
———
317

Queſt. 3. There are two Numbers, the leaſt whereof 40, and their Difference 14. I dee to know what is the greater umber, and alſo what is the Sum them both? Firſt ſet down the aſt, (*viz.*) 40, and 14, the Difference, and add them together, and eir Sum is 54 for the greateſt umber; then I ſet 40 (the leaſt) der 54 (the greateſt), and add em together; and their Sum is 94, equal to the greateſt and leaſt Numbers.

	40
	14
greateſt	54
leaſt	40
Sum	94

CHAP. V.

Of Reduction *of Whole Numbers.*

UBTRACTION, is the taking of a leſſer Number out of a greater of a like kind, whereby to find a third Number, being or declaring the Inequality, ceſs or Difference between the Numbers given; or *traction* is that by which one Number is taken out of another Number given, to the end that the Reſidu or Remainder may be known, which Remainder is alſ called the Reſt, Remainder, or Difference of the Number given.

2. The Number out of which *Subtraction* is to b made, muſt be greater, or at leaſt equal with the othe Number given; the higher Number is called the *Major*, and the lower the *Minor*; and the Operation of *Subtraction* being finiſhed, the Reſt or Remainder i called the Difference of the Numbers given.

3. In *Subtraction*, place the Numbers given reſpectively, the one under the other, in ſuch ſort as like Degrees, Places or Denominations may ſtand in the ſam Series, *viz.* Units under Units, Tens under Tens Pounds under Pounds, *&c.* Feet under Feet, and Parts under Parts, *&c.* This being done, draw a Line underneath, as in *Addition*.

4. Having placed the Numbers given as is before directed, and drawn a Line under them, ſubtract th lower Number (which in this Caſe muſt always be leſ than the uppermoſt) out of the higher Numbers, an ſubſcribe the Difference or Remainder reſpectively below the Line; and when the Work is finiſhed, th Number below the Line will give you the Remainder.

As for Example, Let 364521 be given to be ſubtracted from 795836, I ſet the leſſer under the greater, a in the Margent, and draw a Line under them; the beginning at the Right Hand, I ſay, 1 out of 6, and there remains 5, which I ſet in order under the Line; then I proceed to the next, ſaying, 2 from 3 reſts 1, which I note alſo under the Line; and thus I go on till I have finiſhed the Work; and then I find the Remainder or Difference to be 431315.

79583
36452
———
43131

But if it ſo happen (as commonly it doth) that th lowermoſt Number or Figure is greater than the uppermoſt; then in this Caſe add ten to the uppermoſt Number, and ſubtract the ſaid lowermoſt Number from the Sum, and the Remainder place under the Line, an when you go to the next Figure below, pay an Un by adding it thereto for the ten you borrowed before, and ſubtract that from the higher Number of Figures, and thus go on until your Subtraction be finiſhed. As for Example; Let 437503 be given, from whence it is required to ſubtract 153827, I diſpoſe of the Numbers as is before directed, and as you ſee in the Margent; then I begin, ſaying, 7 from 3 I cannot, but (adding 10 thereto) I ſay, 7 from 13 and there remains 6, which I ſet under the Line in order; then I proceed to the next Figure, ſaying, 1 that I borrowed and 2 is 3 from 0 I cannot, but 3 from 10 and there remains 7, which I likewiſe ſet down as before; then 1 that I borrowed and 8 is 9, from 5 I cannot, but 9 from 15 and there remains 6; then 1 borrowed and 3 is 4 from 7 and there remains 3; then 5 from 3 I cannot, but 5 from 13, and there remains 8; then 1 I borrowed and 1 are 2 from 4, and there reſts 2; and thus the Work is finiſhed: And after theſe Numbers are ſubtracted one from another, the Inequality, Remainder, Exceſs or Difference, is found to be 283676. Examples for thy farther Experience may be theſe that follow.

437503
153827
———
283076

From	3469916	From	361576
Take	738642	Take	5864
Reſts	2731274	Reſts	355712

6. If the Sum or Number to be ſubtracted is of ſeveral Denominations, place the leſſer Sum below the greater, and in the ſame Rank and Order, as is ſhewed in *Addition* of the ſame Numbers; then begin at the Right-Hand, and take the lower number out of the uppermoſt, if it be leſſer; but if it be bigger than the uppermoſt, then borrow an Unit from the next greater Denomination, and turn it into the Parts of the leſs Denomination, and add thoſe Parts to the uppermoſt, noting the Remainder below the Lines; then proceed and pay one to the next Denomination for that which you borrowed before, and proceed in the Order till the Work be finiſhed. An Example of this Rule followeth: Let 375 *l.* 13 *s.* 7 *d.* 1 *qr.* be given, from

whence let it be required to ſubtract 57 *l.* 16 *s.* 03 *d* 2 *qrs.* In order whereunto, I place the Numbers a you ſee in the Margent; and thus I begin at the leaſt Denomination, ſaying, two from one I cannot, therefore I borrow one Penny from the next Denomination, and turn it into Farthings, which is 4, and adding 4 to 1, which is 5, I ſay, but 2 from 5, and there remains 3, which I put under th Line; then going on, I ſay, 1 that I borrowed and is 4 from 7, and there reſts 3; then going on, I ſay, 16 from 13 cannot, but borrowing 1 Pound, and turning it into 20 Shillings, I add it to 13, and that i (33), wherefore I ſay, 16 from 33, and there remain 17, which I ſet under the Line, and go on, ſaying, that I borrowed and 7 is 8 from 5 I cannot, bu from 15, and there remains 7; the one that I borrowed and 5 is 6 from 7 there reſts 1, and 0 from reſts 3, and the Work is done. And I find the Remainder or Difference to be 317 *l.* 17 *s.* 3*d.* 3 *qrs.*

l.	*s.*	*d.*	*qr*
375	13	07	
57	16	03	
317	17	03	

Another Example of *Troy-weight*, may be this, I woul ſubtract 17 *l.* 10 *oz.* 11 *p.w.* 20 *gr.* from 24 *l.* 5 *oz.* 0 *p.w.* 08 *gr.* I place the Numbers according to the Rule, and begin, ſaying, 20 from 8 I cannot, but borrow 1 penny weight, which is 24 Grains, and add them to 8 and they are 32, wherefore I ſay, 20 from 32 reſts 12; then 1 that I borrowed and 11 is 12 from 00 I cannot, but 12 from 24 (borrowin an Ounce, which is 20 penny-weight) and there remains 8; then 1 that I borrowed and 10 is 11 from I cannot, but 11 from 17 and there reſts 6, then 1 tha I borrowed, and 7 is 8 from 4 I cannot, but 8 from 14 and there reſts 6; then 1 that I borrowed and 1 is from 2, and there reſts nothing; ſo that I find the Remainder or Difference to be 6 *l.* 6 *oz.* 8 *p.w.* 12 *gr.*

l.	*oz.*	*p.w.*	*gr*
24	05	00	0
17	10	11	
06	06	08	1

7. It many times happeneth that you have man Sums or Numbers to be ſubtracted from one Numbe

s ſuppoſe a Man ſhould lend his Friend a certain Sum
f Money, and his Friend hath paid him part of his
ebt at ſeveral times, then before you can convenient-
y know what is ſtill owing, you are to add the ſeve-
al Numbers or Sums of Payments together, and ſub-
ract their Sum from the whole Debt, and the Remain-
er is the Sum due to the Creditor; As ſuppoſe A lend-
th to B 564 *l.* 16 *s.* 10 *d.*
nd B hath repaid him 79 *l.*
6 *s.* 8 *d.* at one time, and
63 *l.* 18 *s.* 11 *d.* at another
ime, and 241 *l.* 15 *s.* 8 *d.*
t another time; and you
ould know how the Ac-
ompt ſtandeth between
hem, or what more is due
o A. In order whereunto
firſt ſet down the Sum
hich A lent, and draw a
Line underneath it, then under that Line ſet the ſeve-
al Sums of Payment as you ſee in the Margent; and
aving brought the ſeveral Sums of Payment into one
otal by the 5th Rule of the fourth Chapter foregoing,
find their Sum amounteth to 485 *l.* 11 *s.* 3 *d.* which
ſubtract from the Sum firſt lent by A, by the ſixth
Rule of this Chapter, and I find the Remainder to be
9 *l.* 5 *s.* 7 *d.* and ſo much is ſtill due to A.

	l.	*s.*	*d.*
Lent	564	16	10
Paid at ſeveral Payments	79	16	08
	163	18	11
	241	15	03
Paid in all	485	11	03
Remains	79	05	07

When the Learner hath good Knowledge of what
ath been already delivered in this and the foregoing
hapters, he will with eaſe underſtand the manner of
orking the following Examples.

Subtraction of Whole Money.

	l.	*s.*	*d.*	*l.*	*s.*	*d.*	*qrs.*
orrowed	374	10	03	700	10	11	2
aid	79	15	11	9	03	11	3
emains	294	14	04	691	06	11	3

	l.	s.	d.	l.	s.	d.	qrs.
Borrowed	1000	00	00	711	03	00	0
Paid	19	00	06	11	13	00	1
Remains	980	19	06	699	09	11	3

	l.	s.	d.	qrs.
Borrowed	3300	00	00	0
Paid at ſeveral Payments	170 361 590 73	10 13 03 04	00 10 04 11	0 1 3 3
Paid in all	1195	12	02	3
Remains due	2104	07	09	1

Subtraction of Troy-weight.

	l.	oz.	p.w.	gr
Bought	174	00	13	0
Sold	78	04	16	1
Remains	95	07	16	0

	l.	oz.	p.w.	gr
Bought	470	10	13	0
Sold at ſeveral times	60 35 16 48 61 23	00 10 07 04 11 00	00 18 09 00 19 00	0 0 0 0 2 0
Sold in all	245	10	07	0
Remains unſold	225	00	05	1

Subtraction of Apothecaries Weights.

	l.	oz.	dr.	ſc.	gr.	l.	oz.	dr.	ſc.	gr.
Bought	12	04	3	0	00	20	00	1	0	07
Sold	8	05	1	1	15	10	00	1	2	12
Remains	03	11	1	1	05	09	11	7	0	15

Subtraction of Averdupois-weight.

	C.	qrs	l.	tu.	C.	qrs.	l.	oz.	dr.
Bought	35	0	15	5	07	1	10	10	05
Sold	16	2	20	3	17	1	16	09	13
Remains	18	2	23	1	09	3	22	00	08

Subtraction of Liquid Measure.

	tu.	hhd.	gal.	tu.	hhd.	gal.	pints
Bought	40	1	30	60	3	42	4
Sold	16	1	40	15	3	46	6
Remains	23	3	53	44	3	58	6

Subtraction of Dry Measure.

	chal.	qrs.	buſh.	pec.	chal.	qrs.	buſh.	pec.
Bought	100	0	0	0	73	2	3	2
Sold	54	1	4	3	46	2	3	3
Remains	45	2	3	1	26	3	7	3

Subtraction of Long Measure.

	yds	qrs.	nails	yds.	qrs.	nails
Bought	160	0	0	344	0	1
Sold	64	1	2	177	1	3
Remains	95	3	2	166	2	2

Subtraction of Land Measure.

	acres	rood	perch	acres	rood	perch
Bought	140	2	13	600	0	00
Sold	70	3	12	54	0	16
Remains	69	2	01	545	3	34

The Proof of Subtraction.

2. When your Subtraction is ended, if you deſire to prove the Work, whether it be true or no; then add the Remainder to the minor Number, and if the Aggregate of theſe two be equal to the major Number, then is your Operation true, otherwiſe falſe: Thus let us prove the firſt Example of the fifth Rule of this Chapter, where after Subtraction is ended, the Numbers ſtand as in the Margent, the Remainder or Difference being 283676. Now to prove the Work, I add the ſaid Remainder 283676 to the minor Number 153827, by the fourth Rule of the foregoing Chapter, and I find the Sum or Aggregate to be 437503, equal to the major Number, or Number from whence the leſſer is ſubtracted. Behold the Work in the Margent.

$$\begin{array}{r} 437503 \\ 153827 \\ \hline 283676 \\ \hline 437503 \end{array}$$

The Proof of another Example, may be of the firſt Example of the 6th Rule of this Chapter, where it is required to ſubtract 57 *l.* 16 *s.* 3 *d.* 2 *qrs.* from 375 *l.* 13 *s.* 7 *d.* 1 *qr.* and by the Rule I find the Remainder to be 317 *l.* 17 *s.* 03 *d.* 3 *qrs.* Now to prove it, I add the ſaid Remainder 317 *l.* 17 *s.* 03 *d.* 3 *qrs.* to the minor number 57 *l.* 16 *s.* 3 *d.* 2 *qrs.* and their Sum is 375 *l.* 13 *s.* 07 *d.* 1 *qr.* equal to the major Number, which proves the Work to be true; but if it had happened to have been either more or leſs than the ſaid major number, then the Operation had been falſe.

l.	*s.*	*d.*	*qrs*
375	13	07	1
57	16	03	2
317	17	03	3
375	13	07	1

6. The general Effect of Subtraction, is, to find the Difference or Exceſs between two Numbers, and the reſt when a Payment is made in part of a greater Sum, the Date of Books printed, the Age of any Thing, by knowing the preſent Year, and the Year wherein they are made, created, or built, and ſuch like.

The Queſtions appropriated to this Rule, are ſuch as follow.

Queſt. 1. What Difference is there between one Thing of 125 Foot long, and another of 66 F. long?

To reſolve this Queſtion, I 1ſt ſet down the major or greater Number 125, and under it the minor or leſſer Number 66, as is directed in the third Rule of this Chapter, and according to the fourth Rule of the ſame, I ſubtract the minor from the major, and the Remainder, Exceſs or Difference, I find to be 59. See the Work in the Margent.

$$\begin{array}{r}125\\66\\\hline 59\\\hline\end{array}$$

Queſt. 2. A Gentleman oweth a Merchant 365 *l.* whereof he hath paid 278 *l.* what more doth he owe?

To give an Anſwer to this Queſtion, I firſt ſet down the major Number 365 *l.* and under it I place 278 the minor, and ſubtract the one from the other, whereby I diſcover the Exceſs, Difference or Remainder, to be 87, and ſo much is ſtill due to the Creditor; as *per* Margent.

$$\begin{array}{r}365\\278\\\hline 87\end{array}$$

Queſt. 3. An Obligation was written, a Book printed, a Child born, a Church built, or any other Thing made in the Year of our Lord 1572, and now we account the Year of our Lord 1687, the Queſtion is to know the Age of the ſaid Things; that is, How many Years are paſſed ſince the ſaid Things were made? I ſay, if you ſubtract the leſſer Number 1572, from the greater 1687, the Remainder will be 115, and ſo many Years are paſs'd ſince the making of the ſaid Things; as by the Work in the Margent.

$$\begin{array}{r}1687\\1572\\\hline 115\end{array}$$

Queſt. 4. There are three Towns lie in a ſtraight Line, *viz.* *London*, *Huntington*, and *York*, now the Diſtance between the fartheſt of theſe Towns, *viz.* *London* and *York*, is 151 Miles, and from *London* to *Huntington* is 49 Miles. I demand, How far it is from *Huntington* to *York*?

To reſolve this Queſtion, ſubtract 49 the Diſtance between *London* and *Huntington*, from 151 the diſtance between *London* and *York*, and the Remainder is 102 for the true Diſtance between *Huntington* & *York*. See the Work in the Margin.

$$\begin{array}{r}151\\49\\\hline 102\end{array}$$

CHAP. VI.

Of Multiplication of Whole Numbers.

1. MULTIPLICATION is performed by two Numbers of like Kind for the Production of a Third, which ſhall have ſuch Reaſon to the one, as the other hath to the Unit, and in Effect is a moſt brief and artificial *Compound Addition* of many equal Numbers of like Kind into one Sum. Or, *Multiplication* is that by which we multiply two or more Numbers, the one into the other, to the End that their Product may come forth, or be diſcovered.

Or, *Multiplication* is the increaſing of any one Number by another, ſo often as there are Units in that Number, by which the other is increas'd, or by having two Numbers given to find a third, which ſhall contain one of the Numbers as many times as there are Units in the other.

2. *Multiplication* hath three Parts. Firſt, The Multiplicand or Number to be multiply'd. Secondly, The Multiplier or Number given by which the Multiplicand is to be multiplied. And thirdly, The Product or Number produced by the other two, the one being multiplied by the other, as if 8 were given to be multiplied by 4. I ſay 4 times 8 is 32; here 8 is the Multiplicand, and 4 is the Multiplier, and 32 is the Product.

$$\begin{array}{r}8\\4\\\hline 32\end{array}$$

3. *Multiplication* is either *Single*, by one Figure; or *Compound*, that conſiſts of many.

Single Multiplication is ſaid to conſiſt of one Figure, becauſe the Multiplicand and Multiplier conſiſt each of them of a Digit and no more; ſo that the greateſt *Product* that can ariſe by *Single Multiplication*, is 81, being the ſquare of 9; and *Compound Multiplication*, is ſaid to conſiſt of many Figures, becauſe the Multiplicand or Multiplier conſiſts of more Places than one; as if I were to multiply 436 by 6: It is called Compound,

becauſe

ecauſe the Multiplicand 436 is of more Places than ne, *viz.* 3 places.

4. The Learner ought to have all the Varieties of *ingle Multiplication* by Heart, before he can well proceed any farther in this Art, it being of moſt excellent Uſe, and none of the following Rules in *Arithmetick*, but what have a principal Dependance thereupon, which may be learnt by the following Table.

Multiplication TABLE.

1	2	3	4	5	6	7	8	9
2	4	6	8	10	12	14	16	18
3	6	9	12	15	18	21	24	27
4	8	12	16	20	24	28	32	36
5	10	15	20	25	30	35	40	45
6	12	18	24	30	36	42	48	54
7	14	21	28	35	42	49	56	63
8	16	24	32	40	48	56	64	72
9	18	27	36	45	54	63	72	81

The Uſe of the precedent Table is this: In the uppermoſt Line or Column you have expreſs'd all the Digits from 1 to 9; and likewiſe beginning at 1 and going downwards in the ſide Column, you have the ſame; ſo that if you would know the Product of any two ſingle Numbers multiplied by one another, look for one of them (which you pleaſe) in the uppermoſt Column, and for the other in the ſide Column, and running your eye from each Figure along the reſpective Columns, in the common Angle (or place) where theſe two Columns meet, there is the Product required. As for Example, I would know how much is 8 times 7; Firſt I look for 8 in the uppermoſt Column, and 7 in the ſide Column; then do I caſt my Eye from 8 along the Column downwards from the ſame, and likewiſe from 7 in the ſide Column, I caſt my Eye from thence toward the Right hand, and find it to meet with the firſt Column at 56, ſo that I conclude 56 to be the Product required, *&c.*

5. In *Compound Multiplication*, if the Multiplicand conſiſts of many places, and the Multiplier of but one Figure; firſt ſet down the Multiplicand, and under it place the Multiplier in the place of Units, and draw a Line underneath them; begin then and multiply the Multiplier into every particular Figure of the Multiplicand, beginning at the place of Units, and ſo proceed towards the Left Hand, ſetting each particular Product under the Line, in order as you proceed: But if any of the Products exceed 10, or any number of Tens, ſet down the Exceſs, and for every 10 carry a Unit to be added to the next Product, always remembring to ſet down the Total Product of the laſt Figure; which Work being finiſhed, the Sum or Number placed under the Line ſhall be the true and total Product required. As for Example, I would multiply 478 by 6: Firſt ſet down 478, and underneath it 6, in the place of Units, and draw a Line underneath them, as in the Margent; then I begin, ſaying, 6 times 8 is 48, which is 8 above four Tens, therefore I ſet down 8 (the Exceſs) and bear four in mind for the 4 Tens; then I proceed, ſaying, 6 times 7 is 42, and 4 that I carried is 46, I then ſet down 6 and carry 4, and go on, ſaying, 6 times 4 is 24, and 4 that I carried is 28, and becauſe it is the laſt Figure, I ſet it all down, and ſo the Work is finiſhed, and the Product is found to be 2868, as was required.

$$\begin{array}{r} 478 \\ 6 \\ \hline 2868 \end{array}$$

6. When in *Compound Multiplication*, the Multiplier conſiſteth of divers places, then begin with the Figure in the place of Units in the Multiplier, and multiply it into all the Figures in the Multiplicand, placing the Product below the Line, as was directed in the laſt Example; then begin with the Figure of the ſecond place of the Multiplier, (*viz.*) the Place of Tens, and multiply it likewiſe into the whole Multiplicand, (as you did the firſt Figure) placing its Pro-

duct under the Product of the firſt Figure; do in the ſame manner by the Third, Fourth, and Fifth, *&c.* until you have multiply'd all the Figures of the Multiplier particularly into the whole Multiplicand, ſtill placing the Product of each particular Figure under the product of its precedent Figure; herein obſerving the following Caution.

A Caution.

In the placing of the product of each particular Figure of the Multiplier, you are not to follow the 2d Rule of the 4th Chapter, *viz.* to place Units under Units, and Tens under Tens, *&c.* but to place the Figure or Cypher in the place of Units of the ſecond Line under the ſecond Figure or place of Tens in the Line above it, and the Figure or Cypher in the place of Units in the third Line under the place of Tens in the ſecond Line, *&c.* obſerving this Order till you have finiſhed the Work, ſtill placing the firſt Figure of every Line or Product under the ſecond Figure or place of Tens in that which was above it, and having ſo done, draw a Line under all theſe particular products, and add them together; ſo ſhall the Sum of all theſe Products be the total product required.

As if it were required to multiply 764 by 27, I ſet them down the one under the other, with a Line drawn underneath them; then I begin, ſaying, 7 times 4 is 28, then I ſet down 8 and carry 2; then I ſay, 7 times 6 is 42, and 2 that I carried is 44, that is 4 and go 4; then 7 times 7 is 49, and 4 that I carry is 53, which I ſet down, becauſe I have not another Figure to multiply; thus I have done with the 7, then I begin with the 2, ſaying, 2 times 4 is 8, which I ſet down under (4) the ſecond Figure or place of Tens in the Line above it, as you may ſee in the Margent; then I proceed, ſaying, 2 times 6 is 12, that is 2 and carry 1, then 2 times 7 is 14, and 1 that I carry is 15, which I ſet down becauſe 'tis the product of the laſt Figure; ſo that the product of 764 by 7 is 5348, and by 2 is 1528, which being placed the one under the other,

$$\begin{array}{r} 764 \\ 27 \\ \hline 5348 \\ 1528 \\ \hline 20628 \end{array}$$

other, as is before directed, as you ſee in the Margent, and a Line drawn under them, and they added together reſpectively, make 20628, the true Product required, being equal to 27 times 764.

Another Example may be this; Let it be required to multiply 5486 by 465, I diſpoſe of the Multiplicand and Multiplier according to the Rule, and begin multiplying the firſt Figure of the Multiplier, which is (5) into the whole Multiplicand, and find the product is 27430; then I proceed, and multiply the 2d Figure (6) of the Multiplier into the Multiplicand, and find the product to amount to 32916, which is ſubſcribed under the other product reſpectively; then do I multiply the third and laſt Figure (4) of the Multiplier into the Multiplicand, and the Product is 21944, which is likewiſe placed under the ſecond Line reſpectively; then I draw a Line under the ſaid Products (being placed the one under the other according to Rule) and add them together, and the Sum is 2550990, the true product ſought, being equal to 5486 times 465, or 465 times 5486.

```
   5486
    465
-------
  27430
 32916
21944
-------
2550990
```

More Examples in this Rule are theſe following.

```
     430865          6400758
       4739            37496
  ---------      ------------
    3877785         38404548
   1292595         57606822
  3016055         25603032
 1723460         44805306
-----------     19202274
 2041869235     ------------
                240002821968
```

Compendium in Multiplication.

7. Although the former Rules are ſufficient for all Caſes in *Multiplication*, yet becauſe in the Work of *Multi-*

Multiplication many times great Labour may be ſaved, I ſhall acquaint the Learner with ſome Compendiums in order thereto, *viz.* If the Multiplicand or Multiplier, or both of them, end with Cyphers, then in your multiplying you may neglect the Cyphers, and multiply only the ſignificant Figures, and to the product of thoſe ſignificant Figures, add ſo many Cyphers as the Numbers given to be multiplied did end with; that is, annex 'em on the Right Hand of the ſaid Product, ſo ſhall that give you the true product required. As if I were to multiply 32000 by 4300, I ſet them down in order to be multiplied, as you ſee in the Margent, but neglecting the Cyphers in both Numbers, I only multiply 32 by by 43, and the product I find to be 1376, to which I annex the 5 Cyphers in the Multiplicand and Multiplier, and then it makes 137600000 for the true product of 32000 by 4300.

Sic numeris propoſitis unus vel uterque adjunctos habeat ad dextram circulos, omiſſis circulis fiat ipſorum numerorum multiplicatio, & facto demum tot inſuper integrorum loci acconſeantur quot ſunt omiſſi circuli in utroque factore Clavis Mat. c. 4. 3.

```
    32000
     4300
---------
    96
   128
---------
137600000
```

8. If in the Multiplier, Cyphers are placed between ſignificant Figures, then multiply only by the ſignificant Figures, neglecting the Cyphers; but here ſpecial Notice is to be taken of the true placing of the firſt Figure after the Neglect of ſuch Cypher or Cyphers; and therefore you muſt obſerve in what place of the Multiplier the Figure you multiply by ſtandeth, and ſet the firſt Figure of that product under the ſame place of the product of the firſt Figure of your Multiplier: As for Example, Let it be required to multiply 371568 by 40007. Firſt I multiply the Multiplicand by 7, & the product is 2600976, then neglecting the Cyphers, I multiply by 4, and that prouct is 1486272;

Si intermedio multiplicantis loco circulus fuerit ille negligitur. Alſted. *c. 6. De Arithm.*

```
     371568
      40007
-----------
    2600976
1486272
-----------
14865320976
```

now I conſider, that 4 is the 5th Figure in the Multiplier, therefore I place 2 (the firſt Figure of the product by 4) under the fifth place of the firſt product by 7, and the reſt in order, and having added them together, the total product is found to be 14865320976. Other Examples in this Rule, are theſe following:

327586	7864371
6030	20604
9827580	31457484
1965516	4716226
	15728742
1975343580	162037500084

9. If you are to multiply any Number by an Unit with Cyphers, *viz.* by 10, 100, 1000, *&c.* then annex ſo many Cyphers before the Multiplicand, and that Number when the Cyphers are annexed, is the product required. If you would multiply 428 by 100, annex 2 Cyphers to 428, and it is 42800. If it were required to multiply 102 by 10000, annex 4 Cyphers, and it gives 1020000 for the product required.

The Proof of Multiplication.

10. *Multiplication* is proved by *Diviſion*, and to ſpeak truth, all other ways are falſe, (according to *Friſius*) and therefore 'twill be neceſſary in the firſt place to learn *Diviſion*, and by that to prove *Multiplication*. There are ſome other ways uſed indeed, but on a ſtrict *Examen*, there is not one in a thouſand of their Products Right; therefore we omit them.

11. The general Effect of *Multiplication*, is contain'd in the Definition of the ſame, which is to find out a third Number, ſo often containing one of the two given Numbers, as the other containeth Units.

The ſecond Effect is, by having the length and breadth of any thing (as a Parallelogram or long Plain) to find the ſuperficial Contents of the ſame, and by having the ſuperficial Content of the Baſe, and the Length, to find out the Solidity of any Parallelopipedon, Cylinder, or other ſolid Figures.

The third Effect is, by the Contents, Price, Value, Buying, Selling, Expence, Wages, Exchange, Simple Intereſt, Gain or Loſs of any one Thing, be it Money, Merchandize, *&c.* to find out the Value, Price, Expence, Buying, Selling, Exchange or Intereſt of any number of Things of like Name, Nature and Kind.

The fourth Effect (is not much unlike the other) by the Contents, Value, or Price of any one part of any Thing denominated, to find out the Contents, Value, or Price of the whole Thing, all the Parts into which the whole is divided, multiplying the Price of one of thoſe Parts.

The fifth Effect is, to aid, to compound, and to make other Rules, as chiefly, the *Rule of Proportion*, called the *Golden Rule*, or *Rule of Three*; alſo by it, Things of one Denomination are reduced to another.

If you multiply any number of Integers, or the Price of the Integer, the product will diſcover the Price of the Quantity, or Number of Integers given.

In a Rectangular Solid, if you multiply the breadth of the Baſe by the depth, and that produce by the length, the laſt product will diſcover the Solidity or Content of the ſame Solid.

Some Queſtions proper to this Rule, may be theſe following.

Queſt. 1. What is the Content of a ſquare piece of Ground, whoſe length is 28 perches, and breadth 13?

Anſwer, 364 ſquare perches; for multiplying 28 the length, by 13 the breadth, the product is ſo much.

Queſt. 2. There is a ſquare Battle, whoſe Flank is 47 Men, and the Files 19 deep, what number of Men doth that Battle contain? *Facit*, 893; for multiplying 47 by 19, the product is 893.

Queſt. 3. If any one Thing coſt 4 Shillings, what ſhall 9 Things coſt? *Anſw.* 36 Shillings; for multiplying 4 by 9, the product is 36.

Queſt. 4. If a piece of Money or Merchandize be worth or coſt 17 Shillings, what ſhall 19 ſuch pieces of Money or Merchandize coſt? *Facit*, 323 Shillings, which is equal to 16*l.* 3 *s.*

Queſt. 5. If a Soldier or Servant get or ſpend 14 *s.* *per* Month, what is the Wages or Charges of 49 Soldiers or Servants for the ſame time? Multiply 49 by 14, the product is 686*s.* or 34*l.* 6*s.* for the Anſwer.

Queſt. 6. If in a Day there are 24 Hours, how many Hours are there in a Year, accounting 365 Days to conſtitute the Year? *Facit*, 8760 Hours; to which if you add the 6 hours over and above 365 Days, as there is in a Year, then it will be 8766 Hours; now if you multiply this 8766 by 60, the Number of Minutes in an Hour, it will produce 525960, the number of Minutes in a Year.

CHAP. VII.

Diviſion of Whole Numbers.

DIVISION, is the ſeparating or parting of any Number or Quantity given, into any parts aſſigned, or to find how often one Number is contained in another; or from any two Numbers given, to find a third that ſhall conſiſt of ſo many Units, as the one of thoſe two given Numbers is comprehended or contained in the other.

2. *Diviſion* hath three parts or numbers remarkable, *viz.* Firſt, The Dividend. 2dly, The Diviſor. 3dly, The Quotient. The Dividend is the Number given, to be parted or divided. The Diviſor is the Number given by which the Dividend is divided, or it is the Number which ſheweth how many parts the Dividend is to be divided into. And the Quotient is the Number produced by the Diviſion of the two given Numbers the one by the other.

So 12 being given to be divided by 3, or into three equal parts, the Quotient will be 4, for 3 is contain'd in 12 four times, where 12 is the Dividend, and 3 is the Diviſor, and 4 is the Quotient.

3. In *Diviſion* ſet down your Dividend, and draw a crooked Line at each End of it, and before the Line at

the Left Hand place the Diviſor, and behind that on the Right Hand place the Figures of the Quotient, as in the Margent, where it is required to divide 12 by 3 : Firſt, I ſet down 12 the Dividend, and on each ſide of it, do I draw a crooked Line, and before that on the Left Hand do I place 2 the Diviſor ; then do I ſeek how often 3 is contained in 12 ; and becauſe I find it four times, I put 4 behind the crooked Line, on the Right Hand of the Dividend, denoting the Quotient.

3) 12 (4

4. But if when the Diviſor is a ſingle Figure, the Dividend conſiſteth of two or more places, then having placed them for the Work (as is before directed) put a point under the firſt Figure on the Left Hand of the Dividend, provided it be bigger than (or equal to) the Diviſor ; but if it be leſſer than the Diviſor, then put a point under the ſecond Figure from the Left Hand of the Dividend ; which Figures as far as the Point goeth from the Left Hand, are to be reckoned by themſelves, as if they had no Dependence upon the other part of the Dividend : And for Diſtinction ſake may be called the Dividual ; then ask how often the Diviſor is contained in the Dividual ; placing the Anſwer in the Quotient ; then multiply the Diviſor by the Figure that you placed in the Quotient, and ſet the Product thereof under your Dividual ; then draw a Line under the Product, and ſubtract the ſaid Product from the Dividual, placing the Remainder under the ſaid Line ; then put a point under the next Figure in the Dividend on the Right Hand of that to which you put the point before, and draw it down, placing it on the Right Hand of the Remainder which you found by *Subtraction* ; which Remainder, with the ſaid Figure annexed before it, ſhall be a new Dividual ; then ſee again how often the Diviſor is contained in this new Dividual, and put the Anſwer in the Quotient on the Right Hand of the Figure which you put there before ; then multiply the Diviſor by the laſt Figure that you put in the Quotient, and ſubſcribe the Product under the Dividual, and make Subtraction, and to the Remainder

mainder drawn down the next Figure from the grand Dividend, (having firſt put a point under it) and put it on the right hand of the Remainder for a new Dividual as before, *&c.* and proceed thus till the Work is finiſhed.

Obſerving this general Rule in all Kinds of *Diviſion.* Firſt, To ſeek how often the Diviſor is contained in the Dividual; then (having put the Anſwer in the quotient) multiply the Diviſor thereby, and ſubtract the Product from the Dividual. An Example or two will make the Rule plain. Let it be required to divide 2184 by 6. I diſpoſe of the Numbers given as is before directed, and as you ſee in the Margent, in order to the Work, then (becauſe 6 the Diviſor is more than 2 the firſt Figure of the Dividend) I put a point under 1 the ſecond Figure, which makes the 21 for the Dividual, then do I ask how often 6 the Diviſor is contained in 21, and becauſe I cannot have it more than three times, I put 3 in the Quotient, and thereby do I multiply the Diviſor (6) and the Product is 18, which I ſet in order under the Dividual, and ſubtract it therefrom, and the Remainder (3) I place in order under the Line, as you ſee in the Margent.

```
6) 2184 (6
    •
```

```
6) 2184 (3
    •
   18
   ————
    3
```

Then do I make a point under the next Figure of the Dividend, being 8, and draw it down, placing it before the Remainder 3, ſo have I 38 for a new Dividual, then do I ſeek how often 6 is contained in 38, and becauſe I can't have it more than 6 times, I put 6 in the Quotient, and thereby do I multiply the Diviſor 6, and the Product (6) I put under the Dividual (38), and ſubtract it therefrom, and the Remainder 2 I put under the Line, as you ſee in the Margent.

```
6) 2184 (36
    ••
   18
   ————
    38
    36
    ————
     2
```

Then do I put a point under the next (and laſt) Figure of the Dividend (being 4) and draw it down to the Remainder 2, and putting it on the Right Hand thereof, it maketh 24 for a new Dividual; then I ſeek how often 6 is contained in 24, and the Anſwer is 4, which I put in the Quotient, and multiply the Diviſor (6) thereby, and the *Product* (24) I put under the Dividual (24) and ſubtract it therefrom, and the Remainder is (0); and thus the Work is finiſhed, and I find the Quotient to be 364, that is, 6 is contained in 2184 juſt 364 times, or 2184 being divided into 6 equal parts, 364 is one of thoſe parts.

```
6) 2184 (364
   ...
   18
   ----
    38
    36
   ----
     24
     24
   ----
     (0)
```

Again, If it were required to divide 2646 by 7, or into 7 equal parts, the Quotient will be found to be 378, as by the following Operation appeareth.

```
7) 2646 (378
   ...
   21
   ----
    54
    49
   ----
     56
     56
   ----
     00
```

So if it were required to divide 946 by 8, the quotient will be found to be 118, and 2 remaining after Diviſion is ended. The Work followeth.

```
8) 946 (118
   ...
   8
   ---
   14
    8
   ---
    66
    64
   ----
    (2)
```

Many times the Dividend cannot exactly be divided by the Diviſor, but ſomething will remain, as in the laſt Example, where 945 was given to be divided by 6, the Quotient was 118, and there remaineth 2 after the Diviſion is ended: Now what is to be done in this Caſe with the Remainder, the Learner ſhall be taught when we come to treat of the reducing (or Reduction) of Fractions.

And here note, That if after your Diviſion is ended, any thing do remain, it muſt be leſſer than your Diviſor; for otherway your work is not rightly performed.

Other Examples are ſuch as follows.

```
8) 73464 (9083                9) 13758 (1528
     ....                           ....
   72                             9
  ____                          ____
   14                             47
    8                             45
  ____                          ____
    66                             25
    64                             18
  ____                          ____
     24                             78
     24                             72
  ____                          ____
    (0)                            (9)
```

5. But if the Diviſor conſiſteth of more places than one, then chooſe ſo many Figures from the Left ſide of the Dividend for a Dividual as there are Figures in the Diviſor, and put a point under the fartheſt Figure of that Dividual to the Right Hand, and ſeek how often the firſt Figure on the Left ſide of the Diviſor is contained in the firſt Figure on the Left ſide of the Dividual, and place the Anſwer in the Quotient, and thereby multiply your Diviſor, placing your Product under your Dividual, and ſubtract it therefrom, placing the Remainder below the Line; then put a point under the next Figure in the Dividend, and draw it down to the ſaid Remainder, and annex it on the right ſide

thereof, which makes a new Dividual, and proceed as before, till the Work is finiſhed.

And if it ſo happen that after you have choſen your firſt Dividual, (as is before directed) you find it to be leſſer than the Diviſor, then put a point under the Figure more near to the right hand, and ſeek how often the firſt Figure on the left ſide of the Diviſor, is contained in the two firſt Figures on the left ſide of the Dividual, and place the Anſwer in the Quotient, by which multiply the Diviſor, and place the product thereof in order under the Dividual, and ſubtract it therefrom, and proceed as before.

Always remembring, (that in all Caſes of *Diviſion*) if after you have multiplied your Diviſor by the Figure firſt placed in the Quotient, the Product be greater than the Dividual, then you muſt cancel that Figure in the Quotient, and inſtead thereof put a Figure leſſer by an Unit (or One) and multiply the Diviſor thereby, and if ſtill the Product be greater than the Dividual, make the Figure in the Quotient yet leſſer by an Unit, and thus do until your Product be leſſer than the Dividual, or at the moſt equal thereto, and then make Subtraction, *&c.*

So if you would divide 9464 by 24, the Quotient will be found to be 394; I firſt put down the given Number as is before directed in the 3d Rule. Now becauſe my Diviſor conſiſteth of two Figures, I therefore put a Point under the ſecond Figure from the Left hand of my Dividend; which there is 4, wherefore I ſeek how often 2 the firſt Figure (on the left ſide of the Diviſor) is contained in 9 (the like firſt in the Dividual) the Anſwer is 4, which I put in the Quotient, and thereby multiply all the Diviſor, and find the Product to be 96, which is greater than the Dividual 94, wherefore I cancel the 4 in the Quotient, and inſtead thereof I put 3 (an Unit leſſer) and by it multiply the Diviſor 24, and the Product is 72, which I ſubtract from 94 the *Dividual*, and the Remainder is 22, then

```
             3
24) 6464 (
     ...     4
     72
    ———
     22
```

then do I make a point under the next Figure 6 in the Dividend, and draw it down & place it on the right ſide of the Remainder 22, and it makes 226 for a new Dividual; now becauſe the Dividual 226 conſiſteth of a Figure more than the Diviſor, therefore I ſeek how often 2 (the 1ſt Figure of the Diviſor) is contained in 22, the two firſt of the Dividual, I ſay 9 times, wherefore I put 9 in the Quotient, and thereby multiply the Diviſor 24, the product (216) I place under the Dividual 226, and ſubtract it from it, and there remaineth 10.

```
24) 9464 (39
     ..
    72
   ----
    226
    216
   ----
     10
```

Then I go on and make a point under the next and laſt Figure (4) in the Dividend, and draw it down to the Remainder 10, and it makes 104 for a new Dividual, which is alſo a Figure more than the Diviſor; and therefore I ſeek how often 2 is contained in 10, I anſwer 5 times; but multiplying my Diviſor by 5, the Product is 120, which is greater than the Diviſor, and therefore I make it but 4, and by it multiply the Diviſor, and the product is 96, which being placed under, and ſubtracted from the Dividual, there remaineth 8; and thus the whole Work of this Diviſion is ended, and I find that 9464, being divided by 24, or into 24 equal parts, is found to be 394, as was ſaid before; and the Remainder is 8, as you ſee in the Work following.

```
24) 9464(394
    ....
    72
   ----
    226
    216
   ----
    104
     96
   ----
    (8)
```

Another Example may be this: Let there be re-ired the Quotient of 1183653 divided by 358; rſt I diſpoſe of the Numbers in der to their dividing, and becauſe 8, the three firſt Figures of the ividend, is leſſer than the Di- ſor 385. I therefore make a int under the fourth Figure, hich is 3, and ſee how often 3 (the firſt Figure of e Diviſor) is contained in 11: The Anſwer is 3, hich I put in the quotient, and thereby multiply the viſor 385, and the Product is 1155, which I ſubtract om the Dividual 1183, and there remains 28. Then s before) I draw down the xt Figure, which is 6, and place before the Remainder 28; ſo ve I 268 for a new Dividual, d becauſe it hath no more Fi- res than the Diviſor, I ſeek how en 3 (the firſt Figure in the Di- ſor) is contained in 2 (the firſt Figure of the Dividu-)and the Anſwer is 0; for a greater Number can't contained in a leſſer, wherefore I put 0 in the quo- nt, and thereby (according to the 5th Rule) I ſhould ltiply the Diviſor; but if I do, the product will be 0, d 0 ſubtracted from the Dividual 286, the Remainder the ſame, wherefore I draw wn the next Figure (5) from e Dividend, and put it before e ſaid Remainder 286, ſo have 86 for a new Dividual; and auſe it conſiſteth of 4 places, . a place more than the Di- or, I ſeek how often 3 (the Figure of the Diviſor) is con- ned in 28 (the two firſt of the vidual) and I ſay, there is 9 times 3 in 28, but mul- lying my whole Diviſor (385) thereby, I find the duct to be 3465; which is greater than the Divi- l 2865; wherefore I chooſe 8, which is leſſer by an

385) 1183653 (3
•
1155
———
28

385) 1183653 (30
••
1153
———
286

385) 1183653 (307
•••
1155
———
2865
2695
———
170

Unit than 9, and thereby I multiply my Diviſor 3
and the product is 3080, which ſtill is greater than
ſaid Dividual, wherefore I chooſe another number
an Unit leſſer, *viz.* 7, and having multiply'd my Di
ſor thereby, the product is 2695, which is leſſer th
the Dividual 2865, wherefore I put 7 in the quotie
and ſubtract 2695 from the Dividual 2865, and th
remains 170; then I draw down the laſt Figure (
in the Dividend, and place it before the ſaid Remai
der 170, and it makes 1703 for a new Dividual; then (for the Reaſon aboveſaid) I ſeek how often 3 is contained in 17, the Anſwer is 5, but multiplying the Diviſor thereby, the product is 1925, greater than the Dividual, wherefore I ſay it will bear 4 (an Unit leſſer) and by it I multiply the Diviſor 385, and the product is 1540, which is leſſer than the Dividual, and therefore I put 4 in the Quotient, and ſubtract the ſaid Product from the Dividu
and there remaineth 163; and thus the Work is fi
ſhed; and I find that 1183653 being divided by 38
or into 385 equal ſhares or parts, (the Quotient
one of thoſe parts) is 3074, and beſides there is 1
remaining.

```
385) 1183654 (30
       ....
     1155
     ----
      3865
      2695
      ----
       1703
       1540
       ----
      (163)
```

And thus the Learner being well-vers'd in the M
thod of the foregoing Examples, he may be ſufficien
ly qualified for the dividing of any greater Sum
Number into as many parts as he pleaſeth, that is,
may underſtand the Method of dividing by a Diviſo
which conſiſteth of 4, or 5, or 6, or any greater Nu
ber of places, the Method being the ſame with t
foregoing Example in every reſpect.

Other Examples in Diviſion.

27986) 835684790 (29860

....

55972

275964

251874

40907

223888

170199

167916

Remains (22830)

196374) 473986018 (2413

....

292748

812380

785496

268841

196637

724678

589122

Remains (135556)

If you divide 47386473 by 58736, you will find the uotient to be 806, and 45257 will remain after the ork is ended.

In like manner if you would divide 3846739204 by 3064, the Quotient will be 7963, and the Remain- r after Diviſion will be 100572.

Compendium in Diviſion.

IF any given Number be to be divided by another Number that hath Cyphers annexed on the right-ſide thereof, (omitting the Cyphers) you may cut ſo many Figures from the Right Hand of the Dividen as there are Cyphers before the Diviſor, and let t remaining Numbers in the Dividend, be divided by t remaining number or numbers of the Diviſor, obſervi this Caution; That if after your Diviſion is ended, a thing remain, you are to annex thereto the number numbers that were cut off from the Dividend; a ſuch new found Number ſhall be the Remainder. (S Mr. *Oughton's Clavis Mathematica*, cap. 5. 3.) As for E ample; Let it be required to divide 46658 by 400, now becauſe there are 2 Cyphers before the Diviſor, I cut off as many Figures from before the Dividend, *viz.* 58, ſo that then there will remain only 466 to be divided by 4, and the Quotient will be 116, and there will remain 2, to which I annex the two Figures (58) which were cut off from the Dividend, and it makes 258 for the true Remainder; ſo that I conclude 46658 being divided by 400, t Quotient will be 116, and 258 remain after the Wo is ended; as by the Work in the Margent.

```
4|00) 466|58 (11
      ...
      4
     ----
      6
      4
     ----
      26
      24
     ----
     (258)
```

2. And hence it followeth, that if the Diviſor be (or an Unit with Cyphers annexed, you may cut off many Figures from before the Dividend, as there a Cyphers in the Diviſor, and then the Figure or Figur that are on the left Hand will be the Quotient, an thoſe that are on the right Hand will be the Re mainder after the Diviſion is ended. (*Vid. Gem. Fri Arith.*) As thus; If 45783 were to be divided by 1 I cut off the laſt Figure (3) with a Daſh thus, 4578| and the Work is done, and the Quotient is 4578 (t Number on the Left Hand of the Daſh) and the Re mainder is 3 (on the right Hand). In like manner the ſame Number 45783 were to be divided by 100, cut off two Figures from the end thus, (453|83) an the quotient is 457, and the Remainder is 83. And

were to divide the ſame by 1000, I cut off 3 Figures om the end thus (45|783), and the Quotient is 45, d 783 the Remainder, *&c.*

6. The general Effect of *Diviſion*, is contained in the efinition of the ſame, (that is) by having two unequal Numbers given, to find a third Number in ſuch roportion to the Dividend, as the Diviſor hath to nit or 1: It alſo diſcovers what Reaſon or Proportin there is between Numbers; ſo if you divide 12 by , it quotes 3, which ſhews the Reaſon or Proportion f 4 to 12 is triple.

The ſecond Effect is, by the ſuperficial Meaſure or ontent, and the length of any Oblong, Rectangular arallelogram, or ſquare Plane known, to find out the readth thereby; or contrarywiſe, by having the ſupercies and breadth of the ſaid Figure, to find out the ngth thereof. Alſo by having the ſolidity and length f a Solid, to find the ſuperficies of the Baſe, *& contra.*

The third Effect is, by the Contents, Reaſon, Price, alue, Buying, Selling, Expences, Wages, Exchange, tereſt, Profit or Loſs of any number of Things (be Money, Merchandize, or what elſe) to find out the ontents, Reaſon, Price, Value, Buying, Selling, Exence, Wages, Exchange, Intereſt, Profit or Loſs, or y one Thing of like Kind.

The fourth Effect is, to Aid, to Compoſe, and to ake other Rules, but principally the Rule of *Proporon*, called the *Golden Rule*, or *Rule of Three*, and the eduction of Monies, Weights and Meaſures of one enomination into another; by it alſo Fractions are bbreviated by finding a Common-Meaſurer, unto the umerator and Denominator, thereby diſcovering ommenſurable Numbers.

If you divide the Value of any certain Quantity by e ſame quantity, the quotient diſcovers the Rate or alue of the Integer; as if 8 Yards of Cloth coſt 29 hillings, if you divide (96) the Value or Price of the ven quantity by (8) the ſame quantity, the quotient ill be 128, which is the Price or Value of 1 of thoſe ards, *& contra.*

If you divide the Value or Price of any unknow Quantity, by the Value of the Integer, it gives you the Quotient that unknown quantity, whoſe Price thus divided ; as if 12 Shillings were the Value of Yard. I would know how many Yards are worth Shillings: Here if you divide (96) the Price or Valu of the unknown quantity (by 12) the Rate of the In teger, or 1 Yard, the Quotient will be 8, which is th Number of Yards worth 96 Shillings.

Some Queſtions anſwered by Diviſion, may be theſe followin

Queſt. 1. If 22 Things coſt 66 Shillings, what will ſuch thing coſt? *Facit* 3 Shillings ; for if you divid 66 by 22, the Quotient is 3 for the Anſwer ; ſo if Yards or Ells of any Thing be bought or ſold for 108 how much will one Yard or Ell be bought or ſold for *Facit* 3 *l.* for if you divide 108 *l.* by 36 Yards, th Quotient will be 3 *l.* the price of the Integer.

Queſt. 2. If the Expence, Charges, or Wages of Years amount to 868 *l.* what is the Expence, Charg or Wages of one Year? *Facit*, 124 *l.* for if you divid 868 (the Wages of 7 Years) by 7 (the Number Years) the Quotient will be 124 *l.* for the Anſwe See the Work.

7) 868 (124
   ...
   7

   16
   14

   28
   28
   ---
   (0)

Queſt. 3. If the Content of one ſuperficial Foot 144 Inches, and the breadth of a Board be 9 Inche how many Inches of that Board in length will mak ſuch a Foot? *Facit*, 16 Inches ; for by dividing 14 the number of ſquare Inches in a ſquare Foot) by 9 the inches in the breadth of the Board) the Quotient is 16 for the number of inches in length of that Board to make a ſuperficial Foot.

9) 144 (16 *inches*
  . . .
  9
  54
  54
  (0)

Queſt. 4. If the Content of an Acre of Ground be 160 ſquare Perches, and the length of a Furlong (propounded) be 80 Perches, how many Perches will there go in breadth to make an Acre? *Facit*, 2 Perches; for if you divide 160, the number of Perches in an Acre, by 80, (the length of the Furlong in perches) the Quotient is 2 perches; and ſo many in breadth of that Furlong will make an Acre.

80) 160 (2 *Perches*
  .
  160
  (0)

Queſt. 5. If there be 893 Men to be made up into a Battle, the Front conſiſts of 47 Men; what number muſt there be in the File? *Facit*, 19 deep in the File; for if you divide 893 (the number of Men) by 47 (the number in the Front) the Quotient will be 19 File in depth. The Work followeth.

47) 893 (19 *deep in File*
  . .
  47
  423
  423
  (0)

Queſt. 6. There is a Table whoſe ſuperficial Content is 72 Feet, and the breadth of it at the End is 3 Feet;

now I demand what is the length of this Table? *Facit*, 24 Feet long; for if you divide 72 (the Content of the Table in Feet) by 3, (the breadth of it) the Quotient is 24 Feet for the length thereof, which was required. See the Operation as in the Margent.

3) 72 (
•
6
———
12
12
———
(0)

The Proof of Multiplication and Diviſion.

Multiplication and *Diviſion* interchangeably prov each other; for if you would prove a Sum in *Diviſio* whether the Operation be right or no, multiply th Quotient by the Diviſor; and if any thing remain aft the Diviſion is ended, add it to the product, whic product (if your Sum was rightly divided) will be equal to the Dividend. And contrarywiſe, if you would prove a Sum in Multiplication, divide the product by the Multiplier, and if the Work was rightly performed, the Quotient will be equal to the Multiplicand. See the Example, where the Work is done and undone. Let 7654 be given to be multiplied by 3242, the product will be 24814268, as by the Work appeareth.

765
324
———
1530
30616
15308
22962
———
2481426

And then if you divide the ſaid product 24814268 by 3242 the Multiplier, the Quotient will be 7654, equal to the given Multiplicand.

3242) 24814268 (7654
••••
22694
———
21202
19452
———
17506
16210
———
12968
12968
———
(0)

In like manner (to prove a Sum or Number in *Diviſion)* 24814268 were divided by 3242, the Quotient will be found to be 7654; then for Proof, if you multiply 7654 the Quotient, by 3242 the Diviſor, the product will amount to 24814268, equal to the Dividend.

Or you may prove the laſt, or any other Example in *Multiplication*, thus, *viz.* Divide the product by the Multiplicand, and the Quotient will be equal to the Multiplier. See the Work.

```
           7654
           3242
         ------
          15308
         30616
        15308
       22962
       --------
7654)  24814268  (3242
         ....
         22962
         ------
          18522
          15308
          ------
           32146
           30616
           ------
            15308
            15308
            ------
             (0)
```

From whence there ariſeth this Corollary, that any Operation in *Diviſion*, may be proved by *Diviſion*; for if after your *Diviſion* is ended, you divide the Dividend by the Quotient, the new Quotient thence ariſing will be equal to the *Diviſor* of the firſt Operation; for trial whereof, let the laſt Example be again repeated.

```
3242) 24814268 (7654
          ....
      22694
      -----
       21202
       19452
       -----
        17506
        16210
        -----
        12968
        12968
        -----
         (0)
```

For Proof whereof divide again 24814268 by the Quotient 7654, and the Quotient hence will be equal to the firſt Diviſor 3242. See the Work.

```
7654) 24814268 (3242
          ....
      22962
      -----
       18522
       15308
       -----
        32146
        30616
        -----
         15308
         15308
         -----
          (0)
```

But in proving *Diviſion* by *Diviſion*, the Learner is to obſerve this following Caution: That if after his Diviſion is ended, there be any Remainder, before you go about to prove your Work, ſubtract the Remainder out of your Dividend, and then Work as in the following Example, where it is required to divide 43876 by 765, the Quotient here is 57, and the Remainder is 271. See the Work following.

765)

```
765) 43876 (57
      ••

     3825
     ----
     5626
     5355
     ----
     (271)
```

Now to prove this Work, ſubtract the Remainder 271 out of the Dividend 43876, and there remaineth 43605 for a new Dividend to be divided by the former Quotient 57, and the Quotient thence ariſing is 765, equal to the given Diviſor, which proveth the Operation to be right.

```
     43876
       271
    ------
57) 43605 (765
      •••

    399
    ---
     370
     342
     ---
      285
      285
      ---
      (0)
```

Thus have we gone through the four Species of *Arithmetick*, *viz.* *Addition*, *Subtraction*, *Multiplication*, and *Diviſion*, upon which all the following Rules, and all other Operations whatſoever, that are poſſible to be wrought by Numbers, have their immediate dependance, and by them are reſolved. (Vide *Gem. Friſ.* Arith. part 1.) Therefore before the Learner make a farther ſtep in this Art, let him be well acquainted with what hath been delivered in the foregoing Chapters.

CHAP.

CHAP. VIII.

Of Reduction.

1. REDUCTION, is that which brings together two or more Numbers of different Denominations into one Denomination, or it ſerveth to change or alter Numbers, Money, Weight, Meaſure of Time, from one Denomination to another; and likewiſe to abridge Fractions to the loweſt Terms. All which it doth ſo preciſely, that the firſt Proportion remaineth without the leaſt jot of Error or Wrong committed; ſo that it belongeth as well to Fractions as Integers; of which in its proper place. *Reduction* is generally performed either by *Multiplication* or *Diviſion*; from whence we may gather; That

Hill's Arith. c. 13. p. 152.

2. *Reduction* is either deſcending or aſcending.

3. *Reduction* deſcending, is when it is required to reduce a Sum or Number of a greater Denomination, into a leſſer; which *Number* when it is ſo reduced, ſhall be equal in Value to the Number firſt given in the greater Denomination; as if it were required to know how many *Shillings*, *Pence* or *Farthings*, are equal in Value to 100 *l.* Or, how many Ounces are contained in 4500 Weight: Or, how many Days, Hours, or Minutes, there are in 240 Years, *&c.* And this kind of *Reduction* is generally performed by *Multiplication*.

Wing. Arith. 3. 7. 2, 3, 4.

4. *Reduction* aſcending, is when it is required to reduce or bring a Sum or Number of a ſmaller Denomination into a greater, which ſhall be equivalent to the given Number; as ſuppoſe it were required to find out how many *Pounds*, *Shillings* or *Pence*, are equal in Value to 43785 *Farthings*: Or, how many Hundreds are equal to (or in) 3748 *Pounds*, &c. and this Kind of *Reduction* is always performed by *Diviſion*.

5. When any Sum or Number is given to be reduced into another Denomination, you are to conſider whe-

ther it ought to be reſolved by the Rule deſcending or aſcending, *viz.* by *Multiplication*, or *Diviſion*; if it be to be performed by *Multiplication*, conſider how many parts of the Denomination into which you would reduce it, are contained in an Unit or Integer of the given Number, and multiply the ſaid given Number thereby, and the Product thereof will be the Anſwer to the Queſtion. As if the Queſtion were in 38 pounds, how many Shillings? Here I conſider, that in one Pound are 20 Shillings, and that the number of Shillings in 38 pounds, will be 20 times 38, wherefore I multiply 38 *l.* by 20, and the product is 760, and ſo many Shillings are contained in 38 Pounds, as in the Margent.

$$\begin{array}{r}38\\20\\\hline 760\end{array}$$

But when there is a Denomination or Denominations between the Number given and the Number required, you may (if you pleaſe) reduce it into the next inferior Denomination, and then into the next lower than that, &c. until you have brought it into the Denomination required. As for Example, Let it be demanded in 132 *Pounds*, how many Farthings? Firſt, I multiply 132 (the Number of Pounds given) by 20 to bring it into Shillings, and it makes 2640 Shillings, then do I multiply the Shillings 2640 by 12, to bring them into Pence, and it produceth 31680, and ſo many Pence are contained in 2640 Shillings, or 132 Pounds, then do I multiply the *Pence*, *viz.* 31680 by 4 to bring them into Farthings, (becauſe 4 Farthings is a Penny) and I find the *Product* thereof to be 126720, and ſo many Farthings are equal in Value to 132 Pounds. As by the Work in the Margent.

$$\begin{array}{rl}132 & \textit{Pounds}\\20 & \\\hline 2640 & \textit{Shillings}\\12 & \\\hline 5280 & \\2640 & \\\hline 31680 & \textit{Pence}\\4 & \\\hline 126720 & \textit{Farth.}\end{array}$$

6. And if the Number propounded to be reduced is to be divided, or wrought by the Rule aſcending,

conſider how many of the given Numbers are equal to an Unit or Integer in that Denomination to which you would reduce your given Number, and make that your Diviſor, and the given Number your Dividend; and the Quotient thence ariſing will be the number ſought or required; As for Example, let it be required to reduce 2640 Shillings into Pounds. Here I conſider that 20 Shillings are equal to one Pound; wherefore I divide 2640 (the given Number) by 20, and the Quotient is 132, and ſo many *Pounds* are contained in 2640 Shillings. In *Reduction* deſcending and aſcending, the Learner is adviſ'd to take particular Notice of the Tables deliver'd in the ſecond Chapter of this Book, where he may be informed what Multipliers or Diviſors to make uſe of in the reducing of any Number to any other Denomination whatſoever, eſpecially Engliſh Money, Weights, Meaſures, Time and Motion; but in this place it is not convenient to meddle with Foreign Coyns, Weights or Meaſures.

```
                l.
2|0) 264|0 (132
        ..
        2
     -----
        6
        6
     -----
        4
        4
     -----
       (0)
```

But if in *Reduction* aſcending, it happen that there is a Denomination or Denominations between the Number given and the Number required, then you may reduce your Number given into the next ſuperior Denomination, and when it is ſo reduced, bring it into the next above that, and ſo on until you have brought it into the Denomination required. As for Example,

Let it be demanded in 126720 Farthings, how many Pounds? Firſt I divide my given Number, being Farthings, by 4, to bring them into Pence, (becauſe 4 Farthings make one penny) and there are 31680 pence, then I divide 31680 pence by 12, and the Quotient giveth 2640 Shillings, and then I divide 2640 Shillings by 20, and the Quotient giveth 132 Pounds, which are equal in Value to 126720 **Farthings**: See the whole Work as it followeth.

```
          12)      2|0)     l.
4) 126720 (31680 (264|0 (132
   .....    ...     ..
    12       24     2
   ---      ---    ---
     6       76     6
     4       72     6
   ---      ---    ---
     27      48     4
     24      48     4
   ---      ---    ---
      32    (0)    (0)
      32
     ---
     (0)
```

7. When the Number given to be reduced, confiſteth of divers Denominations, as *Pounds*, *Shillings*, *Pence*, and *Farthings*, or of *Hundreds*, *Quarters*, *Pounds*, and *Ounces*, &c. then you are to reduce the higheſt (or greateſt) Denomination into the next inferior, and add thereunto the Number ſtanding in the Denomination, which your greateſt or higheſt Number is reduced to; then reduce that Sum into the next inferior Denomination; adding thereto the Number ſtanding in that Denomination; do ſo until you have brought the Number given into the Denomination propos'd. As if it were required to reduce 48 *l.* 13 *s.* 10 *d.* into *Pence*; firſt I bring 48 *l.* into *Shillings*, by multiplying it by 20, and the Product is 960 *Shillings*; to which I add the 13 *Shillings*, and they make 973; then I multiply 973 by 12, to bring the *Shillings* into *Pence*, and they make 11676 *Pence*, to which I add the 10 *d.* and they make 11686 *Pence* for the *Anſwer*. See the Work done.

```
     l.  s.  d.
     48--13--10
     20
    ------
    960 Shillings
Add  13
    ------
Sum 973 Shillings
     12
    ------
    1946
    973
    ------
   11676 Pence
Add  10
    ------
S. 11686 Pence
```

8. If in Reduction aſcending, after Diviſion is ended, any thing remain, ſuch Remainder is of the ſame Denomination with the Dividend.

Example, In 4783 Farthings, I demand how many Pounds?

Firſt, I divide the given Number or Farthings, *viz.* (4783) by 4, to bring them into Pence, and the Quotient is 1195 Pence, and there remaineth 3 after the work of Diviſion is ended, which is 3 Farthings.

Again, I divide 1195 Pence (the ſaid quotient) by 12, to reduce them into Shillings, and the Quotient is 99 Shillings, and there is a Remainder of 7, which is 7 Pence.

And then divide 99 Shillings (the laſt quotient) by 20, to bring it into Pounds, and the quotient is 4 *l.* and there remaineth 19 Shillings; ſo that I conclude that in 4783 (the propoſed Number of Farthings) there is 4 Pounds, 19 Shillings, 7 Pence, 3 Farthings. View the following Operation.

```
                 12)    2|0
      4) 4783   (1195   9|9 (4 Pounds
           ..      ..
         4       108    8
        ---     -----  -----
         7       115 (19) Shillings
         4       108
        ---     -----
        38 rem.  (7) Pence
        36
     -------             l.  s.  d  qrs.
        23      Facit   04  19  07  03
        20
      -----
Rem. (3) Farthings
```

More Examples in Reduction of Coin.

Queſt. 1. In 438*l.* how many Shillings? *Facit*, 8760 Shillings; for by multiplying 438 by 20, the product amounteth to ſo much. See the Work in the Margent.

```
   438 l.
    20
  ------
facit 8760s.
```

Queſt. 2. In 467 *l.* how many Pence? Firſt multiply the given Number of Pounds (467) by 20, to bring into Shillings, and it makes 9340 Shillings; then multiply the Shillings by 12, and it produceth 112080 Pence, as in the Margent.

$$\begin{array}{r l} 467 & \textit{Pounds} \\ 20 & \\ \hline 9340 & \textit{Shillings} \\ 12 & \\ \hline 18680 & \\ 9340 & \\ \hline \textit{facit}\ 112080 & \textit{Pence} \end{array}$$

Or it may be reſolved thus, *viz.* multiply the given Number of *Pounds* (467) by (240) the Number of *Pence* in a *Pound*, and the Product is the ſame, *viz.* 112080 Pence, as by the Operation appeareth.

$$\begin{array}{r l} 467 & \textit{Pounds} \\ 240 & \\ \hline 18680 & \\ 934 & \\ \hline \textit{Facit}\ 112080 & \textit{Pence} \end{array}$$

Queſt. 3. In 5673 *l.* How many *Farthings*? Firſt multiply the given Number by 20, to bring it into *Shillings*, and it produceth 113460 *Shillings*, then multiply that product by 12, to bring it into *Pence*, and it produceth 1361520 *Pence*; then laſtly multiply the *Pence* by 4, and it produceth 5446080 *Farthings*. See the Operation.

$$\begin{array}{r l} 5673 & \textit{Pounds} \\ 20 & \\ \hline 113460 & \textit{Shillings} \\ 12 & \\ \hline 226920 & \\ 113460 & \\ \hline 1361520 & \textit{Pence} \\ 4 & \\ \hline \textit{Facit}\ 5446080 & \textit{Farthings.} \end{array}$$

Or this *Queſtion* might have been thus reſolved, *viz.* multiply 5673 (the given number of pounds) by 960 (the number of Farthings in a pound) and it produceth the ſame Effect, as you may ſee by the Work.

	5673 *Pounds*	20 *Shillings*
	960	12
	340380	240 *Pence*
	51057	4
Facit	5446080 *Farthings*	960 *Farthings*

Otherwiſe thus: Firſt, Bring the given Numbers 5673 *l.* into Shillings, and multiply the Shillings by 48, the Number of Farthings in a Shilling, and the ſame Effect is thereby likewiſe produced, *viz.*

	5673 *Pounds*	12 *Pence*
	20	4
	113460 *Shillings*	48 *Farthings*
	48	
	907680	
	453840	
Facit	5446080 *Farthings*	

Theſe various Ways of Operations are expreſs'd to inform the Judgment of the Learner, with the Reaſon of the Rule. More Ways may be ſhewn, but theſe are ſufficient even for the meaneſt Capacities.

Queſt. 4. In 458 *l.* 16 *s.* 7 *d.* 3 *qrs.* how many Farthings? To reſolve this Queſtion, conſider the 7th Rule of this Chapter, and work as you are there directed, and you find the aforeſaid given Numbers to amount to 440479 Farthings, *viz.*

l. *s.* *d.* *qrs.*

458—16—7—3

20

9160

Add 16 *ſhillings*

Sum 9176 *ſhillings*

12

18352

9176

110112 *pence*

Add 7

Sum 110119 *pence*

4

440476 *farthings*

Add 3

Sum 440479 *farthings*

This laſt *Queſtion*, or any other of this kind, may be more conciſely reſolved thus; *viz.* When you multiply the pounds by 20, to bring them into Shillings, to the Product of the firſt Figure, and the Figure ſtanding in the place of Units in the Denomination of Shillings; but becauſe the firſt Figure in the Multiplier is (0) I ſay, 0 times 8 is nothing, but 6 is 6, which I put down for the firſt Figure in the Product, then becauſe the Multiplier is 0, I go on no further with it; for if I ſhould, the whole product would be 0, but proceed, and when I come to multiply by the ſecond Figure in the Multiplier, to the product of it, I add the Figure ſtanding in the place of Tens in the Denomination of Shillings, which is (1), ſaying, 2 times 8 is 16, and (the ſaid Figure) 1 is 17; then I ſet down 7, and carry the Unit to the product of the next Figure, as is directed in the 5th Rule of the 6th Chapter foregoing; and finiſh the Work. So that now you may have the whole product and Sum of Shillings at one Operation, which is the ſame as before; and when you multiply the Shillings by 12, to bring them into pence (after the ſame manner) add to the product the Number ſtanding in the Denomination of Pence, and ſo when you multiply the pence by 4, then bring them into Farthings, add to the product the Number ſtanding under the Denomination of Farthings. See the laſt Queſtion thus wrought.

```
     l.   s.  d. qrs.
    458—16—7—3
     20
   ———————
    9176 ſhillings
      12
   ———————
   18359
   9176
   ———————
  110119 Pence
       4
   ———————
Facit 440479 Farthings.
```

After the Method laſt preſcribed, are all the following Examples, that are of the ſame Nature, wrought and reſolved.

Queſt. 5. In 4375866 Farthings, I demand how many *Pounds*, *Shillings*, *Pence*, and *Farthings?*

To reſolve this Queſtion, Firſt, I divide the given Number of Farthings by 4, and the quotient is 1093966 pence, and there remaineth 2 after the Diviſion is ended which (by the 8th Rule foregoing) is two Farthings, then I divide 1093956 Pence by 12, and the quotient is 91163 Shillings, and there remaineth 10 after Diviſion, which by the ſaid 8th Rule is ſo many pence, *viz.* 10 *d.* then I divide 91163 Shillings by 20, and the quotient is 4558*l.* and there remaineth 3 Shillings; ſo the Work is finiſhed, and I find that in 4375866 Farthings, there are 4558 *l.* 3 *s.* 10 *d.* 2 *qrs.* See the Operation.

12)

```
                 12)            2|0)         l.
4) 4375866  (1093966  (9116|3  (4558
   ......      .....     ....

   4             108      8
  ----          ----     ---
   37             13      11
   36             12      10
  ----          ----     ---
    15             19      11
    12             12      10
   ----          ----     ---
     38            76      16
     36            72      16
    ----          ----     ---
     26            46      (3) s.
     24            36
    ----          ----
      26          (10) d.
      24
     ----
     (2) qrs.
```

```
          l.          s.           d.          qrs.
Facit,  4558 ——————— 3 ——————— 10 ——————— 2
```

Queſt. 6. In 4386 *l.* I demand how many Groats?

To reſolve this Queſtion, I reduce the given Number of pounds into Shillings, and they are 87720 Shillings; now I conſider that in a Shilling are 3 Groats, therefore I multiply the Shillings by 3, and it produceth 263160 Groats. See the Work.

```
              4386 Pounds
                20
         ----------
           87720 Shillings
               3
        ----------
Facit,  263160 Groats
```

This Queſtion might have been otherwiſe reſolved thus, *viz.* conſidering that in a Pound (or 20 Shillings,) there are three times 20 Groats, which makes 60, by which I multiply the Number of Pounds given, and it produceth the ſame Effect at one Operation, as followeth.

```
          4386 Pounds
            60 Groats in 20 s.
        ——————
Facit, 263160 Groats 4386 l.
```

Queſt. 7. In 43758 Three-pences, I deſire to know how many Pounds?

To reſolve this, and many ſuch like Queſtions; Firſt, I divide my given Number of Three-pences by 4, becauſe 4 Three-pences are in a Shilling, and the Quotient is 10939 Shillings, and there remaineth 2 after Diviſion is ended, which is two Three-pences (by the 8th Rule of this Chapter) which are equal in Value to 6 *d.* then I divide 10939 Shillings by 20, and the Quotient giveth 546 *l.* and 19 *s.* remains; ſo that I conclude in 43758 Pieces of Three-pence *per* Piece, there are 546 *l.* 19 *s.* 6 *d.* as by the Work appeareth.

```
              2|0        l.    s.   d.
   4) 43758 (1093|9 (546—19—06
      ....    ..
      4        10
     ———      ———
      37        9
      36        8
     ———      ———
      15       13
      12       12
     ———      ———
       38      19 ſhillings
       36
      ———
     (2) Three-pences, or 6 d.
```

This Queſtion might have been otherwiſe reſolved thus, *viz.* Firſt multiply the given Number of 3 pence 43758, by three the number of pence in 3 pence, and the product (*viz.* 13174) is the number of pence equal to the given number of 3 pences, which number of pence may be brought into Pounds by dividing by 12 and by 20, and the Quotient you will find to be equal to the former Work, *viz.* 546 *l.* 19 *s.* 6 *d.*

```
        43758
            3
  ----------  2[0       l.   s.   d.
 12) (131274  (1093[9  (546—19—6
       .....     ...
       12       10
     ------   ------
       112       9
                 8
     ------   ------
        47      13
        36      12
     ------   ------
       114  re. (19) ſhillings
       108
     ------
       (6) Pence Rem.
```

Or thus, Divide the given Number of 3 pences by the number of 3 pences in a Pound, or 20 Shillings (which you will find to be 80, if you multiply 20 *s.* by 4, the number of 3 pences in a ſhilling) and you will find the quote to be 549 *l.* as before, and a Remainder of 78 Three pences; and if you divide thoſe 78 Three pences by 4 (becauſe there are 4 Three-pences in a Shilling) you will find the quote to be 19 *s.* and 2 Three-pences remain, which are equal to 6 *d.* which is the ſame that was before found.

```
8|0) 4375|8 (546—19—6        80
     ...                      4
    -----                   ----
     40                      20
    -----
     37
     32
    -----
      55
      48
    -----
 4) 78 (19 s.
     ..
     4
    -----
     38
     36
    -----
     (2) Three-pences or 6 d.
```

Queſt. 8. In 4785 *l.* 13 *s.* how many pieces of 13 ½ *d.* *per* piece?

This Queſtion cannot be reſolved by Reduction, deſcending or aſcending, abſolutely (becauſe 13 ½ *d.* is no even part of a pound) but rather by them both jointly, *viz.* by Multiplication and Diviſion; for if you bring the number given into half-pence, and divide the half-pence, by the half-pence in 13 ½ *d.* *viz.* 27 the Quotient, will be the Anſwer; for having brought 4785 *l.* 13 *s.* into Half-pence, I find it makes 2297112, which I divide by 27, (becauſe there are ſo many Half-pence in 13 ½ *d.*) and the quote gives 85078 pieces of 13½ *d.* and 6 half pence remain over and above: Obſerve the Work following.

4785

l. s.
4785—13
20

95713 ſhillings
24 half-pence in a ſhilling

382852
191426

2297112 half-pence in the given Number

s.
13 ½ *d.*
2

27 half-pence

27) 2297112 (85078 pieces of 13 ½ *d.*
• • • • •
216

137
135

211
189

222
216

Rem. (6) half-pence

It would have produced the ſame Anſwer, if you ad reduced your given Number into Farthings, and ivided by the Farthings in 13 ½ *d. viz.* 54 ; (for al- ays the Dividend and the Diviſor muſt be of one De- omination) and then you would have had a Remain- er of 12 Farthings, which are equal in value to the rmer Remainder of 6 half-pence, as you may prove your leiſure.

Queſt. 9. In 540 Dollars at 4 *s.* 4 *d. per* Dollar, how any pounds Sterling ?

Firſt, bring your given Number of Dollars into ence, and then your Pence into Pounds according the former Directions, Thus in 4 *s.* 4 *d.* (*viz.* a Dol-) you will find 52 Pence, by which multiply 540 ollars, and it produceth 28080 Pence, which if you

divide

divide by 240 (the Pence in one Pound) the Quotien will give you 117 *l.* which are equal in value to 54 Dollars, at 4 *s.* 4 *d. per* Dollar.

```
                  s.  d.
       540        4—4
        52        12
     ——————      ————
      1080        52
     2700
     ———————
24|0) 2808|0 (117 l.
      • • •
      24
      ———
      40
      24
      ———
      168
      168
      ————
      (0)
```

The foregoing Queſtion might have been otherwiſe wrought, thus; *viz.* Multiply (540) your given Number of Dollars, by 13 the Number of Groats in a Dollar (or 4 *s.* 4 *d.*) and it produceth 7020 Groats, which divide by 60 (the Groats in one pound or 20 Shillings) and the Quote is 117 *l.* as before. See the Work.

```
                      s.
       540            4—
        13            3
     ——————          ———
      1620           13
      540
    ———————
6|0) 702|0 (117
     • • •
     6
     ———
     10
      6
     ———
     42
     42
     ———
     (0)
```

Queſt. 10. In 547386 Pieces of 4 ½ *d. per* piece, I demand how many Pounds, Shillings, and Pence ?

Firſt bring your given number of Four-pence halfpennies all into half-pence, which you will do if you multiply by 9, the number of half-pence in 4 ½ *d.* and the Product is 4926474 half-pence, which are brought into Pounds, if you divide them by 24 (the half-pence in a Shilling) and 20 (the Shillings in a Pound) it makes 10263 *l.* 9 *s.* 9 *d.*

```
                                                d.
                                                4 ½
       547386                                   2
            9                                 -----
      ---------  2|0)           l.              9 half pence
  24) 4926474 (205261|9 (10263
      .......   .....
      48          2
     ----       -----
      126         05
      120          4
     ----       -----
       64         12                       l.     s.   d.
       48         12                 Facit 10263—9—9
     ----       -----
      167          6
      144          6
     ----       -----
      234 rem. (9) ſhillings
      216
     ----
```

Rem. (18) half pence, or 9 d.

Queſt. 11. In 4386 *l.* I demand how many pieces of 6 *d.* of 4 *d.* and of 2 *d.* of each an equal Number ? that is to ſay, What number of Six-pences, Groats, and Two-pences will make up 4386 *l.* and the number of each equal ?

The way to reſolve Queſtions of this Nature, is to add the ſeveral pieces (into which the given numbers is to be brought) into one Sum, and reduce the given Number into the ſame Denomination with their Sum, and to divide the ſaid given Number (ſo reduced) by the ſaid Sum, and the Quotient will give you the exact Number of each piece. And after the ſame Method will we proceed to reſolve the preſent queſtion, *viz.*

4386 pounds — 6 d.
240 pence — 4
2

175440
8772 — Sum 12 d.
12) 1053640 (87720
. . . . . .
96
92
84
86
84
24
24
(0)

d. d. d.
Facit 87720 pieces of 6—4—2

So that I conclude by the Operation that 87720 Six-pences, and 87720 Groats, and 87720 Two pences, are juſt as much as (or equal to) 4386 *l.* or if you admit of 5 *s.* to be thus divided, it is equal to 5 Six-pences, and 5 Four-pences or Groats, and 5 Two pences.

Another Queſtion of the ſame Nature with the laſt, may be this following, *viz.*

Queſt. 12. A Merchant is deſirous to change 148 *l.* into pieces of 13 *d.* ½ of 12 *d.* of 9*d.* of 6 *d.* of 4 *d.* and he will have of each ſort an equal number of pieces, I deſire to know the Number?

Do as you were taught in the laſt Queſtion, *viz.* add the ſeveral pieces together, and reduce the Sum into Half-pence, then reduce the Sum to be changed, *viz.* 148 *l.* into the ſame Denomination, and divide the greater by the leſſer, and in the quotient you will find the Anſwer, *viz.* 798 is the number of each of the pieces required, and 18 remaineth, which is 18 Half-pence by the 8th Rule of this Chapter. See the Work as followeth:

l.
148
240 pence in a pound

5920
296

35520 pence in 148 *l.*
2

71040 half pence

d.
13 ½
12
9
6
4

Sum 44
2½

89 half pence

89) 71040 (798 pieces of each ſort
...
623

874
801

730
712

Rem. (18) half pence

The truth of the two foregoing Operations will thus be proved, *viz.* Multiply the Anſwer by the parts or pieces into which the given Number was reduced, and having added the ſeveral Products together, if their Sum be equal to the given Number, the Anſwer is Right; otherwiſe not.

So the Anſwer to the 11th Queſtion was 87720; which is proved as followeth, *viz.*

		l.
87720	*Six-pences make* ——	2193
	Four-pences make ——	1462
	Two-pences make ——	731

The Total Sum of them 4386 *which was the Sum given to be changed.*

The Anſwer to the 12th Queſtion was 798, and 18 half pence remain'd after the Work was ended, now the Truth of the Work may be proved as the former was, *viz.*

		l.	s.	d.
798	pieces of 13 makes	44	17	09
	pieces of 12 makes	39	18	00
	pieces of 9 makes	29	18	06
	pieces of 6 makes	19	19	00
	pieces of 4 makes	13	06	00
	and 18 half pence, or 9*d.* remains	00	00	09
	The Total Sum of them	148	00	00

which total Sum is equal to the Number that was firſt given to be changed, and therefore the Operation was rightly performed.

Reduction of Troy-weight.

We now come to give the Learner a few Examples in *Troy weight*; in working whereof he muſt be mindful of the Table of *Troy-weight* delivered in the ſecond Chapter of this Book.

Queſt. 13. In 482 *l.* 7 *oz.* 13 *p.w.* 21 *gr.* how many Grains?

Multiply by 12, by 20, and by 24, taking in the Figures ſtanding in the ſeveral Denominations, according to the Directions given in the 7th Rule of this Chapter, and you will find the Product to be 2780013 Grains, which is the Number required, or Anſwer to the Queſtion. See the whole Work as in the Margent.

l. *oz.* *p.w.* *gr.*
482—7—13—21
12
———
971
482
———
5791 *ounces*
20
———
115833 *penny weight*
24
———
463333
231668
———
Facit 2780013 *grains.*

Queſt. 14. In 2780013 Grains, I demand how many ounds, ounces, penny-weights, and grains?

This is but the foregoing Queſtion inverted, and is eſolved by dividing by 24, by 20, and by 12, and the nſwer is 482 *l* 7 *oz.* 13 *p.w.* 21 *gr.*

```
                      2|0)         12)
24)  2780013     (11583|3     (5791     (482 l.
     ......       ....         ...

     24           10           48
     ---          ---          ---
     38           15           99
     24           14           96
     ---          ---          ---
     140          18           31
     128          18           24
     ----         ---          ---
     200           3     Rem. (7) ounces
     192           2
     ----         ---
      81 Rem. (13) penny weight
      72
     ----
      93                     l.  oz. p.w. gr.
      72            Facit, 482—7—13—21
     ----
```

Remains (21) Grains

Queſt. 15. A Merchant ſent to a Goldſmith 16 Ingots of Silver, each containing in Weight 2 *l.* 4 *oz.* and ordered it to be made into Bowls of 2 *l.* 8 *oz. per* Bowl, and Tankards of 1 *l.* 6 *oz. per* Piece, and Salts of 10 *oz.* 10 *p. w. per* Salt, and Spoons of 1 *oz.* 18 *p. w. per* Spoon, and of each an equal Number; I deſire to know how much of each ſort he muſt make?

This Queſtion is of the ſame Nature with the 11 and 12th Queſtion foregoing, and may be anſwered after the ſame Method, *viz.* Firſt add the Weight of the ſeveral Veſſels (into which the Silver is to be made) into one Sum, and reduce to one Denomination, and they make 1248 Penny-weights; then reduce the Weight of the Ingot into the ſame Denomination, *viz.*

penny-weights, and it makes 560 penny weights) and multiply them by the Number of Ingots, *viz.* 16, and the product will give you the Weight of the 16 Ingots, *viz.* 8960, then divide the Product by the Weight of the Veſſels, *viz.* 1248, and the Quotient giveth you the Anſwer to the Queſtion, *viz.* 7, and 224 *p.w.* remaineth over and above.

l. oz.
2——4
12
28
20
560 penny weights
16 Ingots
3360
560
1248) 8960 (7 Veſſels of each
8736
Rem. (224) penny weight

l. oz. p.w.
2—08—00
1—06—00
0—10—10
0—01—18
Sum 5—02—08
12
62
20
1248 p. w.

The Proof of the Work is as followeth, viz.

		l. oz. p.w			*l. oz. p.w.*
7	*Bowls of*	2—08—00	*per Bowl,*	*is*	18—08—00
	Tank. of	1—06—00	*per Tank.*	*is*	10—06—00
	Salts of	0—10—10	*per Salt,*	*is*	06—01—10
	Spoons of	0—01—18	*per Spoon,*	*is*	00—01—06
		224 *penny weight remaining*			00—11—04
				Total Sum	37—04—00

So that you ſee the Sum of the Weight of each Veſſel together with the Remainder is 37 *l.* 4 *oz.* which is equal to the Weight of the 16 Ingots delivered. For if 37 *l.* 4 *oz* be reduced to Penny weights, it makes 8960.

Reduction

Reduction of Averdupois-weight.

In reducing *Averdupois weight*, the Learner muſt have recourſe to the Table of *Averdupois-weight*, delivered in the ſecond Chapter following.

Queſt. 16. In 47 *C.* 1 *qr.* 20 *l.* how many Ounces? Multiply by 4, by 28, and 16, and the laſt Product will be the Anſwer, *viz.* 84992 Ounces. See the Margent.

```
 C.  qr.  l.
47 — 1 — 20
 4
-----------
199 quarters
 28
-----------
1512
380
-----------
5312 l.
  16
-----------
31872
5322
-----------
```

Facit, 84992 ounces

Queſt. 17. In 84992 Ounces, I demand how many *C. qrs. l.* and *oz.*

This is the foregoing Queſtion inverted, and will be reſolved if you divide by 16, by 28, and by 4, and the Anſwer is 47 *C.* 1 *qr.* 20 *l.* equal to the given Number in the foregoing Queſtion.

```
            28)     4)     C.  qr.  l.   oz.
16) 84992  (5312   (189   (47 — 1 — 20 — 00
    ....    ...     ..
    80      28      16
    ----    ----    ----
     49     251      29
     48     224      28
    ----    ----    ----
     19     172     (1) qrs
     16     252
    ----    ----
     32     (20) pounds
     32
    ----
    (0)
```

Reduction of Liquid Meaſure.

Queſt. 18. In 45 Tun of Wine, how many Gallons? Multiply by 4, and by 63, the Product is 11340 Gallons for the Anſwer.

45
4

180
63

540
1080

Facit, 11340 Gallons

Queſt. 19. In 34 Rundlets of Wine, each containing 18 Gallons, I demand how many Hogſheads?

Firſt, find how many Gallons is in the 34 Rundlets, which you may do if you multiply 34 by 18, the content of a Rundlet, and the product is 612 Gallons, which you may reduce into Hogſheads, if you divide them by 63, and the Quote will be 9 Hogſheads, and 45 Gallons. See the Work.

34
18

272
34

63) 612 (9 hdds

567

Remains (45) Gallons

Facit, 9 hdds, 45 Gallons

Queſt. 20. In 12 Tuns how many Rundlets of 1 Gallons *per* Rundlet?

Reduce your Tuns into Gallons, and divide them b 14, the Gallons in a Rundlet, and that Quotient (216 is your Anſwer. See the Work following.

1

12
4
48
63
144
288
14) 3024 (216 Run.
28
22
14
84
84
(0) *Facit* 216 Rundl.

Reduction of Long Meaſure.

Queſt. 21. I demand how many Furlongs, Poles, Inches and Barly-corns will reach from *London* to *York*, it being accounted 151 Miles?

151 *miles*
8 *furlongs in a mile*
1208 *furlongs*
40 *poles in a furlong*
48320 *poles*
11 *half yards in a pole*
48320
48320
531520 *half yards*
18 *inches in half a yard*
4252160
531520
9567360 *inches*
3 *barly-corns in* 1 *inch*
Facit 28702080 *barly-corns in* 151 *Miles*

Queſt. 22. The Circumference of the Earth (as al other Circles are) is divided into 360 Degrees, an each Degree into 60 Minutes, which (upon the Superficies of the Earth) are equal to 60 Miles; now I demand how many Miles, Furlongs, Perches, Yards, Feet, and Barly-corns, will reach round the Globe of the Earth?

360 *degrees*
60 *minutes or miles in 1 degree*
———
21600 *miles about the Earth*
8 *furlongs in a mile*
———
172800 *furlongs about the Earth*
40 *perches in a furlong*
———
6912000 *poles or perches about the Earth*
11 *half yards in a perch*
———
6912000
6912000
———
2) 76032000 *half yards about the Earth*
———
(38016000 *yards, viz. the half yards*
3 *divided by* 2
———
114048000 *feet about the Earth*
12 *inches in a foot*
———
228096000
114048000
———
1368576000 *inches about the Earth*
3 *barley-corns in an inch*
———
Facit, 4105728000 *barley corns*

And ſo many will reach round the World, the whole being 21600 Miles; ſo that if any Perſon were to go round, and go 15 Miles every Day, he would go the whole Circumference in 1440 Days, which is 3 Years, 11 Months, and 15 Days.

Reduction of Time.

Queſt. 23. In 28 Years, 24 Weeks, 4 Days, 16 Hours, 30 Minutes, how many Minutes?

years weeks days hours minutes

28 —— 24 —— 4 —— 16 —— 30

52 *weeks in a year*

60

142

1489 *weeks*

7

10364 *days*

24

41462

20729

248752 *hours*

60

14925150 *minutes*

Note, That in reſolving the laſt *Queſtion* after the Method expreſs'd, there is loſt in every Year 30 Hours. For the Year conſiſteth of 365 Days and 6 Hours; but by multiplying the Years by 52 Weeks, which is 364 Days, you loſe 1 Day and 6 Hours every Year; wherefore to find an exact Anſwer, bring the odd Weeks, Days and Hours into Hours, and then multiply the Years by the number of Hours in a Year, *viz.* 8766, 8766, and to the product add the Hours contained in the odd time, and you have the exact time in Hours, which bring into Minutes, as before. See the laſt Queſtion, thus reſolved.

weeks *days* *hours*
24—4—16
7
172
24
694
345
4144 *hours*

days *hou.*
365—6
24
1466
730
8766 *hours in a Year*

28
8766
172
172
197
228
249592 *hours*
60
14975520 *Minutes in* 28 *Years, and* 4144 *Hours*

So you ſee that according to the Methods firſt uſed to reſolve this Queſtion, the Hours contained in the given Time are 248752; but according to the laſt, beſt or trueſt Method they are 249592, which exceeds the former by 840 Hours.

But for moſt Occaſions it will be ſufficient to multiply the given Years by 365, and to the product add the Days in the odd Time, if there be any, and then there will be only a Loſs of ſix Hours in every Year, which may be ſupply'd by taking a fourth part of the given Years, and adding it to the contained Days, and you have your Deſire.

Queſt. 24. In 438657540 Minutes, how many Years? *Facit*, 834 Years, 4 Days, 19 Hours.

```
                  8766          years  days  hours
6|0) 43865754|0  (7310959  (834——4——19
     ••••••••      •••
     42           70128
     ——           —————
      18           29815
      18           26298
     ——           —————
       6            35179
       6            35064
     ——             —————
      57        24)  115 (4 days
      54              •
     ——               96
       35             ——
       30         Rem. (19) Hours
     ——
        54
        54
     ——
       (0)
```

Queſt. 25. I deſire to know how many Hours and Minutes it is ſince the Birth of our Saviour Jeſus Chriſt to this preſent Year, being accounted 1722 Years?

This Queſtion is of the ſame Nature with the 24th foregoing, and after the ſame manner is reſolved, *viz.* multiply the given Number of Years by 8766, the product is 15095052 Hours, and that by 60, and the product is 905703120 Minutes. See the Work.

```
        1722 Years
        8766 Hours in a Year
    ————————
       10332
      10332
     12054
    13776
    ————————
    15095052 hours in 1722 Years
          60
    ————————
   905703120 minutes in 1722 Years.
```

Note, That as Multiplication and Diviſion do interchangeably prove each other, ſo Reduction deſcending and aſcending, prove each other by inverting the Queſtion, as the 13th and 14th, and likewiſe the 16th and 17th Queſtions foregoing by Inverſion do interchangeably prove each other; the like may be performed for the Proof of any Queſtion in Reduction whatſoever.

CHAP. IX.

Of Comparative Arithmetick; viz. *The Relation of Numbers one to another.*

1. COMPARATIVE Arithmetick, is that which is wrought by Numbers, as they are conſidered to have Relation one to another, and this conſiſts either in quantity or in quality. Vide *Boetius's Arith.* Lib. 1. cap. 21.

2. Relation of Numbers in quantity, is the reference or reſpect that the Numbers themſelves have one to another, where the Terms or Numbers propounded are always two, the firſt called the Antecedent, and the other the Conſequent. (See *Wing. Arithm.*)

3. The Relation of Numbers and Quantity conſiſts in the Differences, or in the Rate or Reaſon that is found betwixt the Terms propounded, the Differences of two Numbers being the Remainder found by *Subtraction*, (according to *Alſted.*) but the Rate or Reaſon betwixt two Numbers is the Quotient of the Antecedent divided by the Conſequent, ſo 21 and 7 being given, the Difference betwixt them will be found to be 14, but the Rate or Reaſon that is betwixt 21 and 7, will be found to be triple Reaſon, for 21 divided by 7, quotes 3, the Reaſon or Rate.

4. The Relation of Numbers in quality (otherwiſe called Proportion) is the reference or reſpect that the Reaſon of Numbers have one unto another; therefore the Terms given ought to be more than two. Now the Proportion or Reaſon between Numbers relating one to another, is either Arithmetical, or Geometrical.

5. Arithmetical Proportion is, when divers Numbers differ one from another by equal Reaſon, that is, have equal Differences.

So this Rank of Numbers 3, 5, 7, 9, 11, 13, 15, 17, differ by equal Reaſon, *viz.* by 2, as you may prove.

6. In a Rank of Numbers that differ by Arithmetical Proportion, the Sum of the firſt and laſt Term being multiplied by half the number of Terms, the product is the total Sum of all the Terms.

Or, if you multiply the number of the Terms by the half Sum of the firſt and laſt Terms, the product is the total Sum of all the Terms.

So in the former Progreſſion given, 3 and 17 is 20, which multiplied by 4, *viz.* half the number of Terms, the product gives 80, the Sum of all the Terms; or multiply 8 (the number of Terms) by 10 (half the Sum of the firſt and laſt Term) the product gives 80, as before.

So alſo, 21, 18, 15, 12, 9, 6, 3, being given, the Sum of all the Terms will be found to be 84; for here the number of Terms is 7, and the Sum of the firſt and laſt (*viz.* 21 and 3) is 24, half whereof (*viz.* 12) multiplied by 7, produceth 84, the Sum of the Terms ſought.

7. Three Numbers that differ by Arithmetical Proportion, the Double of the Mean (or middle Number) is equal to the Sum of the Extreams.

So 9, 12, and 15, being given, the double of the Mean 12, (*viz.* 24) is equal to the Sum of the two Extreams 9 and 15.

8. Four Numbers that differ by Arithmetical proportion (either contained or interrupted) the Sum of the two Means is equal to the Sum of the two Extreams.

So 9, 12, 18, 21, being given, the Sum of 12 and 18, will be equal to the Sum of 9 and 21, *viz.* 30; alſo 6, 8, 14, 16, being given, the Sum of 8 and 14 is equal to the Sum of 6 and 16, *viz.* 22, &c. See *Wingate's Arith.* c. 35.

9. Geometrical Proportion (by ſome called Geometrical Progreſſion) is when divers Numbers differ, according to right Reaſon.

So 1, 2, 4, 8, 16, 32, 64, *&c.* differ by Double Reaſon. And 3, 9, 27, 81, 243, 729, differ by Triple Reaſon; 4, 16, 64, 256, *&c.* differ by Quadruple Reaſon, *&c.*

10. In any Numbers that increaſe by Geometrical Proportion, if you multiply the laſt term by the Quotient of any one of the Terms divided by another of the Terms, which being leſs is next unto it, and having deducted, or ſubtracted the firſt Term out of that product, divide the Remainder by a Number that is an Unit leſs than the ſaid Quotient, the laſt Quote will give the Sum of all the Terms.

So 1, 2, 4, 8, 16, 32, 64, being given, firſt I take one of the terms, *viz.* 8, and divide it by the Term which is leſs, and next to it (*viz.* by 4) and the quotient is 2, by which I multiply the laſt Term 64, and the product is 128, from whence I ſubtract the firſt Term, (*viz.* 1) the Remainder is 127, which divided by the quotient 2 made leſs by 1 (*viz.* 1) the quote is 127, for the Sum of all the given Terms, as by the Work in the Margent.

64
4) 8 (2
128
1
1) 127 (127

So if 4, 16, 64, 256, 1024, were given, the Sum of all the Terms will be found to be 1364. For firſt, I divide 64, one of the Terms, by his next leſſer Term, and the quotient is 4, by which I multiply the laſt Term 1024, and it produceth 4096; from whence I ſubtract the firſt Term 4, and the Remainder is 4092, which I divide by the quote leſs by 1, (*viz.* 3) and the quote is 1364, for the total Sum of all the Terms, as *per* Margent.

1024
16) 64 (4
4096
4
3) 4092 (1364

11. Three Geometrical Proportionals given, the Square of the Mean is equal to the Rectangle, or product of the Extreams.

So 8, 16, 32, being given, the Square of the Mean, z, 16, 256, which is equal to the Product of the xtreams 8 and 32, for 8 times 32 is equal to 256.

12. Of Four Geometrical Proportional Numbers ven, the Product of the two Means is equal to the oduct of the two Extreams.

So 8, 16, 32, 64, being given, I ſay, that the pro-uct of the two Means, *viz.* 16 times 32, which is 512, equal to 8 times 64, the product of the Extreams.

Alſo if 3, 9, 21, 69, were given (which are inter-pted) I ſay, 9 times 21 is equal to 3 times 63, which equal to 189.

From hence ariſeth that precious Gem in Arithme-ck, which for the Excellency thereof is called the *olden Rule*, or *Rule of Three.*

CHAP. X.

The Single Rule of Three Direct.

THE *Rule of Three* (not undeſervedly called the *Golden Rule*) is that by which we find out a urth Number in Proportion unto three given Num-rs, ſo as this fourth Number ſought may bear the me Rate, Reaſon and Proportion to the 3d (given) umber, as the ſecond doth to the firſt, from whence is called the *Rule of Proportion.*

2. Four Numbers are ſaid to be Proportional, when e firſt containeth, or is contained by the ſecond, as ten as the third containeth, or is contained by the urth. Vide *Wingate's Arith.* Chap. 8. Sect. 4.

So theſe Numbers are ſaid to be Proportionals, *viz.* , 6, 9, 18; for as often as the firſt Number is con-ined in the ſecond, ſo often is the third contained the fourth, *viz.* twice. Alſo 9, 3, 15, 5, are ſaid be Proportionals; for as often as the firſt Number ontaineth the ſecond, ſo often the third Number ontaineth the fourth, *viz.* 3 times.

3. The *Rule of Three*, is either *Simple* or *Compound.*

4. The Simple (or Single) *Rule of Three*, conſiſte of 4 Numbers; that is to ſay, it hath 3 Numbers give to find out a Fourth, and this is either Direct or In verſe. Vide *Alſted. Matth.* lib. 2. c. 13.

5. The *Single Rule of Three Direct* is, when the pro portion of the firſt Term is to the ſecond, as the 3 is to the 4th, or when it is required that the Numbe ſought, (*viz.*) the 4th Number muſt have the ſam proportion to the 2d, as the 3d hath to the firſt.

6. In the *Rule of Three*, the greateſt Difficulty is t diſcover the order of the 3 Terms of the Queſtion pro pounded, *viz.* which is the firſt, ſecond, and third which that you may underſtand, obſerve, That (of th three given Numbers) two always are of one kind and the other is of the ſame kind with the proportiona Number that is ſought; as in this Queſtion, *viz.* if 4 Yards of Cloth coſt 12 Shillings, what will 6 Yard coſt at that Rate? Here the two Numbers of on kind are 4 and 6, *viz.* they both ſignify ſo many Yards and 12 Shillings in the ſame kind with the Numbe ſought, for the price of 6 Yards is ſought.

Again obſerve, that of the 3 given Numbers thoſe two that are of the ſame kind, one of them muſt be th firſt, and the other the third, and that which is of the ſame kind with the Number ſought, muſt be the ſecond Number in the *Rule of Three*, and that you may know which of the ſaid Numbers to make your firſt, and which your third, know this, that to one of theſe two Numbers, there is always affixed a Demand, and that Number upon which the Demand lieth muſt always be reckoned the third Number. As in the forementioned Queſtion, the Demand is affixed to the Number 6, for it is demanded, what 6 Yards will coſt, and therefore 6 muſt be the third Number, and 4 (which is of the ſame Denomination or Kind with it) muſt be the firſt, and conſequently the Number 12 muſt be the ſecond; and then the Numbers being placed in the forementioned Order will ſtand as followeth, *viz.*

yards

yards	*s.*	*yards*
4	12	6

7. The next Thing is, to find out the fourth Number n Proportion; which that you may do, multiply the econd Number by the third, and divide the product hereof by the firſt, or (which is all one) multiply the d Term (or Number) by the ſecond, and divide the roduct thereof by the firſt, and the Quotient thence riſing is the 4th Number in a direct proportion, and is he Number ſought, or Anſwer to the Queſtion, and is f the ſame Denomination that the ſecond Number is f. As thus, Let the ſame Queſtion be again repeated, iz. If 4 Yards of Cloth coſt twelve Shillings, what vill 6 Yards coſt?

Having placed my *Numbers* according to the ſixth Rule (of this Chapter) foregoing, I multiply (the ſecond Number) 12, by (the third Number) 6, and the product is 72, which product I divide by (the firſt Number) 4, and the Quotient thence ariſing is 18, which is the 4th proportional or Number ſought, *viz.* 18 Shillings, (becauſe the ſecond Number is Shillings) which is the price of Yards, as was required by the Queſtion. See the Work following.

yds *s.* *yds.* *s.*
If 4——12——6——18
6

4) 72 (18 Shillings
..
4

32
32

(0)

Queſt. 2. Another Queſtion may be this, *viz.* If 7 *C.* of pepper coſt 21 *l.* how many will 16 *C.* coſt at that Rate?

To reſolve which queſtion, I conſider that (accor ing to the ſixth Rule of this Chapter) the Terms Numbers ought to be placed thus,*viz.*the Demand lyi upon 16 *C.* it muſt be the third Number,and that of t ſame kind with it muſt be the firſt, *viz.* 7 *C.* and 21 (being of the ſame kind with the Number ſought) mu be the ſecond Number in this Queſtion; then I procee according to this 7th Rule, and multiply the ſecon Number by the 3d, *viz.* 21 by 16, and the Product i 336, which I divide by the firſt Number 7, and th Quotient is 48 *l.* which is the Value of 16 *C.* of Pep per at the Rate of 21 *l.* for 7 *C.* See the Work follow ing.

```
 C.         l.        C.
 7 ———————— 21 ——————— 16
            16
          ——————
           126
           21
        ——— ———
      7) 336 (48 l.
          ..
          28
        ——————
           56
           56 Facit 48 l.
        ————————
          (0)
```

8. If when you have divided the product of the 2 and 3d Numbers by the firſt, any thing remain after *Di viſion* is ended, ſuch Remainder may be multiplied b the parts of the next inferior Denomination, that a equal to an Unit (or Integer) of the ſecond Numbe in the Queſtion, and the product thereof divide b the firſt Number in the Queſtion, and the Quotient i of the ſame Denomination with the parts by whic you multiplied the Remainder, and is part of the 4t Number which is ſought. And furthermore, if an

thin

hing remain, after this laſt Diviſion is ended, multiply it by the parts of the next inferior Denomination equal to an Unit of the laſt Quotient, and divide the Product by the ſame Diviſor, (*viz.* the firſt Number is the Queſtion) and the quote is ſtill of the ſame Denomination with your Multiplier; follow this Method until you have reduced your Remainder into the loweſt Denomination, *&c.* An Example or two will make this Rule very plain, which may this following.

Queſt. 3. If 13 Yards of Velvet, *&c.* coſt 21 *l.* what will 27 Yards of the ſame coſt at that Rate?

Having ordered and wrought my Numbers according to the 6th and 7th Rules of this Chapter, I find the Quotient to be 43 *l.* and there is a Remainder of 8, ſo that I conclude the Price of 27 Yards to be more than 43 *l.* and to the Intent that I may know how much more, I work according to the foregoing Rule, *viz.* I multiply the ſaid Remainder 8 by 20 *s.* (becauſe the ſecond Number in the Queſtion was pounds) and the Product is 160, which divided by the firſt Number, *viz.* 13, it quotes 12, which are 12 Shillings, and there is yet a Remainder of 4, which I multiply by 12 pence, (becauſe the laſt Quotient was Shillings) and the product is 48, which I divide by 13, (the firſt Number) and the Quotient is 3 *d.* and yet there remaineth 9, which I multiply by 4 Farthings, and the product is 36, which divided by 13 again, it quotes 2 Farthings, and there is yet a Remainder of 10, which (becauſe it cometh not to the Value of a Farthing) may be neglected; or rather ſet after the 2 Farthings over the Diviſor, with a Line between them; and then (by the 21ſt and 22d Definitions of the firſt Chapter of this Book) it will be $\frac{10}{13}$ of a Farthing; ſo that I conclude, that if 13 Yards of Velvet coſt 21 *l.* 37 Yards of the ſame will coſt 43 *l.* 12 *s.* 3 *d.* 2 $\frac{10}{13}$ *qrs.* which Fraction is 10 thirteens of a Farthing. See the Operation as followeth.

yds l. yds
If 13——21——27
27
147
42
13) 567 (43 *l.*
52
47
39
Remains (8)
Multiply 20
13) 160 (12
13
30
26
Remains (4)
Multiply 12
13) 48 (3 d.
39
Remains (9)
Multiply 4
qrs.
13) 36 ($2\frac{10}{13}$
26
l. s. d. qrs
Remains 10 *facit* 43—12—3—$2\frac{10}{13}$

Queſt. 4. Another Example may be this following, *viz.* If 14 *l.* of Tobacco coſt 27 *s.* what will 478 *l.* coſt at that rate?

Work according to the laſt Rule, and you'l find it o amount to 921 *s.* 10 *d.* 1 $\frac{2}{14}$ *qrs.* and by the 5th ule of the 8th Chapter 921 *s.* may be reduced to 46*l.* . So that then the whole worth or value of the 478*l.* ill be 46*l.* 1*s.* 10*d.* 1 $\frac{2}{14}$ *qrs.* The whole Work followeth.

```
               l.  s.   d.
            If 14--27--478
                        27
                     ------
                      3346
                      956
                   ---------2|0
                 14)12906(92|1 (46 l.
                    ....   ..
                    126     8
                   -----  -----
                    30     12
                    28     12
                   -----  -----
                    26    (1) s.
                    14
                  -----
         Remains  (12)
         Multiply  12
                  -----
                   24
                   12
                  -----
         14)      144 (10 d.
                   ..
                   14
                  ----
         Remains  (4)
         Multiply  4
              14) (16) 1 2/14
                   14
                  -----
         Remains  (2)
         l.  s.  d. qrs.
  Facit, 46--1--10--1 2/14
```

S. In

9. In the *Rule of Three* it many times happeneth, th although the firſt and third *Numbers* be of one kin as both Money, Weight, Meaſure, *&c.* yet they m not be of one Denomination, or perhaps they may bo conſiſt of many Denominations; in which Caſe you a to reduce both Numbers to one Denomination; a likewiſe your ſecond Number (if it conſiſteth at a time of divers Denominations) muſt be reduced to t leaſt Name mentioned, or lower if you pleaſe, whi being done, multiply the ſecond and third togeth and divide by the firſt, as is directed in the 7th Ru of this Chapter.

And note, That always the Anſwer to the queſti is in the ſame Denomination that your ſecond Numb is of, or is reduced to, as was hinted before.

Queſt. 5. If 15 Ounces of Silver be worth 3*l.* 1 what are 86 Ounces worth at that Rate?

In this Queſtion, the Numbers being ordered acco ing to the 6th Rule of this Chapter, the firſt and Numbers are Ounces, and the ſecond Number is of vers Denominations, *viz.* 3*l.* 15*s.* which muſt be duced to Shillings, and the Shillings multiply'd by t third Number, and the Product divided by the fi gives you the Anſwer in Shillings, *viz.* 430 Shilli which are reduced to 21*l.* 10*s.*

```
          oz.    l.      s.    oz.
      If  15 —— 3 —— 15 —— 86
                 20
               ——————
                 75
                 86
               ——————
                 450
                 600
               ———————— (2|0 l.   s.
          15) 6450 (43|0 (21—10
               ...
                 60          4
               ——————      ————
                 45          3
                 (0)       (10) Shill.
```

In reſolving the laſt queſtion the Work would have
en the ſame, if you had reduced you Second Num-
r into pence, for then the Anſwer would have been
60 pence equal to 21*l.* 10*s.* or if you had reduced
e ſecond Number into Farthings, the Quotient or
nſwer would have been 20640 Farthings, equal to
e ſame, as you may prove at your Leiſure.

Queſt. 6. If 8 *l.* of Pepper coſt 4*s.* 8*d.* what will 7 *C.*
rs. 14 *l.* coſt? In this Queſtion the firſt Number is
, and the third is 7 *C.* 3 *qrs.* 14 *l.* which muſt be
luced to the ſame Denomination with the firſt, *viz.*
o Pounds, and the ſecond Number muſt be reduced
o pence; then multiply and divide according to the
Rule foregoing, and you will find the Anſwer to
6174 pence, which is reduced into 25*l.* 14*s.* 6*d.*

```
  l.   s. d.           C. qrs. l.
f 8 coſt 4—8  what will 7—3—17 coſt?
         12              4
        ----           -----
         56             31
                         28
                       ------
                        152
                         63
                       ------
                        882
                         56 ſecond Number
                       ------
                       5292
                      4410
                    -------- 12)    2|0)  l.  s.  d
               8)  49392 (6174(51|4(25—14—6
                   ....    ...   ..
                    48       60    4
                   ----     ----  ---
                    13       17    11
                     8       12    10
                   ----     ----  ----
                    59       54   (14) s.
                    56       48
                   ----     ----
                    32      (6) d.
                    32
                   ----         l.  s.  d.
                   (0) Facit 25—14—6
```

Queſt.

Queſt. 7. If 3 *C.* 1 *qr.* 14 *l.* of Raiſins coſt 9 *l.* what will 6 *C.* 3 *qrs.* 20 *l.* of the ſame coſt?

Here the firſt and third Numbers each conſiſt of vers Denominations, but muſt be brought both i one Denomination, &c. as you ſee in the Operati that followeth, the Anſwer is 388 *s.* which is redu into 19 *l.* 8 *s.*

```
   C. qr. l.         l.  s.              C. qr. l.
If 3—1—14   coſt  9—9  what will  6—3—20 coſt
     4               20                    4
   ------          ------               ------
    13              189                   27
    28                                    28
   ------                               ------
   108                                   216
    27                                    56
   ------                               ------
   378 pounds                            776 pounds
                                         189 ſecond num
                                       --------
                                        6984
                                       6208
                                       776
                                   ----------2|0)   l.
                            378) 146664 (38|8 (19
                                             2
                                 1134      -----
                                ------       18
                                 3326        18
                                 3024      -----
                                ------      (8)
                   l.  s.        3024
            Facit, 19—8          3024
                                ------
                                  (0)
```

Queſt. 8. If in 4 weeks I ſpend 13 s. 4 d. how will 53 l. 6 s. laſt me at that rate?

Anſwer, 2238 Days, equal to 6 years, 48 days. the Work.

s. d. w. l. s.
If 13 — 4 require 4 what will 53 — 6 coſt ?
12 7 20

30 28 days 1066
13 12

160 2132
1066

12792 pence
28 ſec. number

102336
25584
3 95)
16|0) 35817|6 (2238 (6 years
.... 2190

32 Rem (48) days

38
32

61 ye. days.
48 *facit* 6—48 $\frac{96}{160}$

137
128

Remains (96)

ueſt. 9. Suppoſe the Yearly Rent of a Houſe, a
y Penſion, or Wages, be 73 *l.* I deſire to know
much it is *per* Day ?

re you are to bring the Year into Days, and ſay,
3 Days require 73 *l.* what will 1 Day require ?
w when you come to multiply 73 by 1, the Pro-
s the ſame ; for 1 neither multiplieth nor divi-
and 73 cannot be divided by 365, becauſe the

Diviſor is bigger than the Dividend ; wherefore bri the 73 *l.* into Shillings, and they make 1460, whi divide by the firſt Number 363, and the quote is Shillings for the Anſwer : As you ſee in the Work.

Days 1. Day
If 365——73——1
20

365) 1460 (4 s.
1460 *Facit* 4 s per D
(0)

Queſt. 10. A Merchant bought 14 Pieces of Bro Cloth, each piece containing 28 Yards, for which gave after the Rate of 13 *s.* 6 ½ *d.* per Yard ; no deſire to know how much he gave for the 84 pieces that Rate?

Firſt find out how many Yards are in the 14 piec which you will do if you multiply the 14 pieces by (the Number of Yards in a piece) and it makes 39 then ſay, If 1 Yard coſt 13 *s.* 6 *d.* ½ what will Yards coſt? Work as followeth, and the Anſwer will find to be 127400 half pence, which redu make 265 *l.* 8 *s.* 4 *d.* For after you have multipl your ſecond and third Numbers together, the prod is 127400, which (according to the ſeventh R ſhould be divided by the firſt Number ; but the Number is 1, which neither multiplieth nor divide and therefore the Quotient or 4th Number is the with the product of the ſecond and third ; whic in Half-pence, becauſe the ſecond Number was duced. See the Work as followeth.

```
                         28
                         14
                        ----
                        112
                         28
                        ----
                        392 yards in the 14 pieces.

  yd      s. d.         yds
If 1 coſt 13 6 ½ what will 392 coſt ?
          12            325 the ſecond number.
         ----          -----
          32           1960
         13             784
         ----         1176
         162          ------    2|0)
           2       24) 127400 (5301|8 (265 l.
         ----           ....
half pen. 325         120       4
                     -----    -----
                      74        13
                      72        12
                     -----    -----
                     200        10
                     192        10
                     -----    -------
                              (8) ſhillings.
```

l. s. d. Rem. (8) half pence, or 4 d.

cit 265—8—4

Queſt. 11. A Draper bought 420 Yards of Broad-
oth, and gave for it after the Rate of 14 *s.* 10¾ *d.*
Ell *Engliſh*, now I demand how much he paid for
e whole after that Rate ?

Bring your Ells into quarters, and your given yards
o quarters, the Ell is 5 quarters, and in 420 yards,
1680 quarters; then ſay, if 5 quarters coſt 14 *s.*
¾ *d.* (or 715 Farthings), what will 1680 quarters
t ? *Facit*, 250 *l.* 5 *s.* See the Operation.

```
        Ell                 Yards
         1                   420
         5                     4
       -----              --------
         5                  1680 qrs.

  qrs.     s.        d.
If 5 ———— 10 ———— 10¾ ———— 1680
          12                  715
       -------             ---------
          28                 8400
          15                1680
       -------             11760
         178 d.           ——————————96|0
           4              5) 1201200 (24024|0 (250l
       -------               ......
         715 qrs.             10          192
                            -----      --------
                              20         482
                              20         480
                            -----      --------
                                12 rem.(240) qrs. of
                                10
                              -------
                                20
                                20
        l.   s.  d.           -------
 Facit, 250—5—0                 (0)
```

Queſt. 12. A Draper bought of a Merchant 50 piece of Kerſeys, each piece containing 34 Ells *Engliſh*, (th Ell *Flemiſh* being 3 quarters of a yard) to pay after th rate of 8 *s.* 4 *d. per* Ell *Flemiſh*, I demand how muc the 50 pieces coſt him at that rate?

Firſt find out how many Ells *Flemiſh* are in the 5 pieces by multiplying 50 by 34, the product is 1700 which bring into quarters by 3, it makes 5100 quar ters; then proceed as in the laſt Queſtion, and the Anſwer you will find to be 102000 pence, or 425 *l.* e the Operation as followeth.

```
   qrs.  s.   d.           qrs.
If 5 — 8 — 4 ———————— 5100            50
      12                 100           34
   ————             ——————— d.    ——————
   100 d. 5)         510000 (10200 200
                      ....           150
                      5             ——————
                    ——————           1700 Ells Flem.
                      10                3
                      10             ——————
                    ——————           5100
                     (0)             2|0)
                   12) 102000 (850|0 (425 l.
                        ..     .
                        96     8
                      ————   ————
                        60     5
                        60     4
                      ————   ————
                       (0)    10
                              10
                             ————
        Facit 425 l.         (0)
```

Queſt. 13. A Goldſmith bought a Wedge of Gold, which weighed 14 *l.* 3 *oz.* 8 *p. w.* for the Sum of 514 *l.* 4 *s.* I demand what it ſtood him in *per* Ounce? *Anſwer*, 60 Shillings or 3 *l.* See the Work.

```
   l.        oz.       p.w.           l.        s.     oz.
If 14 ——————— 3 ——————— 8 ——————— 514 ——————— 4 ——— 1
   12                              20    ſhillings   20
 ————                            ————               ————
   31                            10284              20 p.w.
   14                              20 p. w.
 ————                          ————————2|0)
  171 oz.            3428) 205680 (6|0 (3 l.
   20                         ..   6
 ————                  205680 ————————
 3428 p.w.             ————————  (0) Facit 60 s. or 3 l.
```

Queſt. 14. A Grocer bought 4 hhds of Sugar, each weighing near 6 *C.* 2 *qrs.* 14 *l.* which coſt him 2*l.* 8*s.* 6*d.* *per*C. I demand the value of the 4 hhds at that rate?

Firſt I find the weight of the 4 hhds, which you may do by reducing the Weight of one of them into pounds, and multiply them by 4 (the Number of hhds) and they make 2968 *l.* Then ſay, If 1 *C.* or 112 *l.* coſt 2*l.* 8*s.* 6*d.* what will 2968 *l.* coſt? *Facit*, 64*l.* 5*s.* 3*d.* As by the Operation.

```
                                               C.    qrs.   l.
                                                6 —— 2 —— 14
                                                4
                                               ————
                                                26
                                                28
                                               ————
                                                212
                                                53
                                               ————
                                                742 l. in 1 hhd.
                                                  4 hogſheads
                                               ————
     l.   l.  s.  d.   l.                       2968 l. in 4 hhds
  If 112—2—8—6—2968                             12)  2|0)
          20           582
        ————         ————
          48          5936
          12         23744
        ————         14840
        102          ————
        48112)      1727376   (15423)128|5 (64 l.
        ————         ••••••     •••   ••
         582          112         12      12
                     ————       ————    ————
                      607         34       8
                      560         24       8
                     ————       ————    ————
                      473        102     (5) ſhillings
                      448         96
                     ————       ————
                      257         63
                      224         60
                     ————       ————
                      336        (3) pence
                      336
                     ————        l.  s.  d.
                      (0)  Facit, 64—5—3
```

Queſt. 15. A Draper bought of a Merchant 8 packs of Cloth, each containg 4 parcels, and each parcel 10 pieces, and each piece 26 yards, and gave after the Rate of 4 *l.* 16 *s.* for 6 yards, now I deſire to know how much he gave for the whole? Anſwer, 6656 *l.*

Firſt find out how many yards there were in the 8 packs, and by the following Work you will find there are 8320 yards; then ſay, If 6 yards coſt 4 *l.* 16 *s.* what will 8320 yards coſt, *&c.*

```
                                          8 Packs
                                          4
                                       ------
                                         32 Parcels
                                         10
                                        320 Pieces
                                         26
                                       ------
yds  l.  s.   yds                      1920
 6—4—16—8320                            640
    20       96                       -------
  -----    -----                       8320 yds.
    96     49920
          74880
         -------
      6) 798720 (13911|0 (6656 l.
         ......  .....
          6        12
        ----     ----
          19       13
          18       12
        ----     ----
           18       11
           18       10
         ----     ----
            7       12
            6       12
          ----     ----
           12       (0)
           12
Facit 6656 l.  ----
           (0)
```

By this time the Learner is (as I ſuppoſe) well exerciſed in the Practick and Theorick of the *Rule of Three Direct*; but at his leaſure he may look over the following Queſtions, whoſe Anſwers are given, but the Operation purpoſely omitted as a Touchſtone for the Learner, thereby to try his Ability in what hath been delivered in the former Rules.

Queſt. 16. If 24 *l.* of Raiſins coſt 6*s.* 6*d.* what will 18 Frails coſt, each weighing neat 3 *qrs.* 18 *l.* *Anſwer*, 24*l.* 17*s.* 3*d.*

Queſt. 17. If an Ounce of Silver be worth 4 Shillings, what is the price of 14 Ingots, each Ingot weighing 7 *l.* 5 *oz.* 10 *p. w.*? *Anſwer*, 313*l.* 5 *s.*

Queſt. 18. If a piece of Cloth coſt 10 *l.* 16*s* 8*d.* I demand how many Ells *Engliſh* there are in the ſame, when the Ell at that rate is worth 8*s.* 4*d.*? *Anſwer*, 26 Ells *Engliſh*.

Queſt. 19. A Factor bought 84 pieces of Stuffs, which coſt him in all 537*l.* 12*s.* at 5*s.* 4*d.* *per* Yard, I demand how many yards there were in all, and how many Ells *Engliſh* were contained in a piece of the ſame? *Anſwer*, 2016 Yards in all, and 19 $\frac{1}{5}$ Ells *Engliſh per* piece.

Queſt. 20. A Draper bought 242 Yards of Broad-cloth, which coſt him in all 254*l.* 10*s.* for 86 yards, of which he gave after the rate of 21*s.* 4*d.* *per* yard, I demand how much he gave *per* Yard for the Remainder? *Anſwer*, 20*s.* 10*d.* $\frac{64}{152}$ *per* yard.

Queſt. 21. A Factor bought a certain quantity of Serge and Shalloon, which together coſt him 126 *l.* 14*s.* 10*d.* The quantity of Serge he bought was 48 yards, at 4*s.* 4*d.* *per* yard; and for every two yards of Serge he had 5 yards of Shalloon; I demand how many yards of Shalloon he had, and how much the Shalloon coſt him *per* yard? *Anſwer*, 120 yards of Shalloon at 1*l.* 16*s.* 5 $\frac{58}{20}$ *per* yard.

Queſt. 22. An Oilman bought three Tuns of Oil, which coſt him 151*l.* 14*s.* and ſo it chanced that it leaked out 83 Gallons; but he is minded to ſell it again ſo that he may be no Loſer by it; I demand how he muſt ſell it *per* Gallon ? *Anſwer*, at 4*s*. $6\frac{174}{671}$ *d. per* Gallon.

Queſt. 23. Bought 6 packs of Cloth, each pack containing 12 Cloths, which at 6*s*. 4*d*. *per* Ell *Flemiſh*, coſt 1080 *l*. I demand how many yards there were in each Cloth ? *Anſwer*, 27 yards in each Cloth.

Queſt. 24. A Gentleman hath 536 *l*. *per Annum*, and his Expences are one Day with another 18*s*. 10*d*. 3*qrs*. I deſire to know how much he layeth up at the Year's end ? *Anſwer*, 191*l*. 3*s*. 0 *d*. 1*qr*.

Queſt. 25. A Gentleman expendeth daily one Day with another 27*s*. $10\frac{1}{2}$ *d*. and at the Year's end layeth up 340 *l*. I demand how much is his yearly Income ? *Anſwer*, 848*l*. 14*s*. $4\frac{1}{2}$*d*.

Queſt. 26. If I ſell 14 yards for 10*l*. 10*s*. how many Ells *Flemiſh* ſhall I ſell for 283*l*. 17*s*. 6*d*. at that rate ? *Anſwer* $504\frac{2}{3}$ Ells Flemiſh.

Queſt. 27. If 100*l*. in 12 Months, gain 6*l*. Intereſt, how much will 75*l*. gain in the ſame time, and at the ſame rate ? *Anſwer*, 4*l*. 10*s*.

Queſt. 28. If 100*l*. in 12 Months gain 6*l*. Intereſt, how much will it gain in 7 Months at that Rate ? *Anſwer*, 3*l*. 10*s*.

Queſt. 29. A certain Uſurer put out 73*l*. for 12 Months, and received Principal and Intereſt 81*l*. I demand what Rate *per Cent*. he received Intereſt ? *Anſwer*, 8 *l*. *per Cent*.

Queſt. 30. A Grocer bought 2 Cheſts of Sugar, the one weighed neat 18 C. 3 *qrs*. 14 *l*. at 2 *l*. 6 *s*. 8 *d*. *per* C. the other weighed neat 18 C. 1 *qr*. 21 *l*. at $4\frac{1}{2}$*d*. *per* *l*. which he mingled together ; now I deſire to know how much a C. *wt*. of this Mixture is worth ? *Anſwer*, 2*l*. 4*s*. $2\frac{5569}{4067}$ *qrs*.

Queſt. 31. Two Men, *viz*. A and B, departed both from one place, the one goes *Eaſt*, and the other *Weſt* ; the one travelleth 4 miles a Day, and the other 5 Miles a Day, how far are they diſtant the 9th Day after their Departure ? *Anſwer*, 91 Miles.

Queſt. 32. A flying every Day 40 Miles, is purſued the fourth Day after by B, poſting 50 Miles a Day ;

now the queſtion is, In how many Days, and after how many Miles Travel, will A be overtaken ?

Anſwer, B overtakes him in 32 Days, when they have travelled 600 Miles. (See *More's Arithm.* cap. 8. qu. 7.

11. The general Effect of the Rule of Three Direct, is contained in the Definition of the ſame, that is, to find a fourth Number in Proportion conſiſting of two equal Reaſons; as hath been fully ſhewn in all the foregoing Examples.

The ſecond Effect is, by the Price or Value of one Thing, to find the Price and Value of many Things of like Kind.

The third Effect is, by the Price and Value of many Things, to find the Price of one; or by the Price of many Things, (the ſaid Price being one) to find the Price of many Things of like Kind.

The 4th Effect is,by the price or value of many things to find the price or value of many things of like Kind.

The 5th Effect is, thereby to reduce any Number of Monies, Weights, or Meaſures, the one ſort into the other, as in the Rules of *Reduction* contained in the 8th Chapter foregoing. Examples of its various Effects have been already anſwered.

The Proof of the Rule of 3Direct.

12. The Rule of Three Direct, is thus proved, *viz.* Multiply the firſt Number by the 4th, and note the Product, then multiply the 2d Number by the 3d, and if this product is equal to the product of the 1ſt and 4th, then the Work is rightly performed, otherwiſe it is erroneous.

So the firſt Queſtion of this Chapter (whoſe Anſwer or 4th Number we found to be 18 *s.*) is thus proved, *viz.* the firſt Number is 4, which multiplied by 18 (the 4th,) produceth 72, and the 2d and 3d Numbers are 12 and 6, which multiplied together produce 72, equal to the product of the 1ſt and 4th, and therefore I conclude the Work to be rightly performed.

Always obſerving, that if any thing remain after you have divided the Product of the ſecond and third

Numbers by the firſt, ſuch Remainder in proving the ſame, muſt be added to the product of the firſt and fourth Numbers, whoſe Sum will be equal to the product of the ſecond and third (the ſecond Number being of the ſame Denomination with the fourth, and the firſt of the ſame Denomination with the third.)

So the fourth Queſtion of this Chapter being again repeated, *viz.* If 14 *l.* of Tobacco coſt 27 *s.* what will 478 *l.* coſt at that Rate? The Anſwer (or fourth Number) was 46*l.* 1*s.* 10*d.* 1*qr.* $\frac{2}{14}$, which is thus proved, *viz.* bring the fourth Number into Farthings, and it makes 44249, which multiplied by the firſt Number 14, produceth 619488, (the ſecond which remaineth being added thereto;) then (becauſe I reduce my fourth Number into Farthings) I reduce my ſecond (*viz.* 27 *s.*) into Farthings, and they are 1296, which multiplied by the third Number 478, their product is 619488, equal to the product of the firſt and fourth Numbers. Wherefore I conclude the Operation to be true. This is an infallible way to prove the *Rule of Three Direct*, and it is deduced from the 12th Section of the 9th Chapter of this Book.

And thus much for this ineſtimable *Rule of Three Direct*; the Demonſtration of which may be ſeen in *Kerſey*'s Appendix to *Wingate*'s Arith. and in the 6th Chapter of *Oughtred's Clavis Mathematica.*

CHAP. XI.

The Single Rule of Three Inverſe.

1. THE Golden Rule, or Rule of Three Inverſe, is when there are 3 Numbers given to find a 4th in ſuch proportion to the 3 given Numbers, ſo as the 4th proceeds from the 2d according to the ſame Rate, Reaſon, or Proportion, that the firſt proceeds from the third, or the Proportion is,

As the 3d Number is in proportion to the 2d, ſo is the 1ſt to the 4th. See *Alſted. Math.* l. 2. c. 14.

So if the 3 Numbers given were 8, 12, and 16, and it were required to find a fourth Number in an inverted proportion to theſe, I ſay, that as 16 (the third Number) is the double of the firſt Term or Number (8) ſo muſt 12 (the ſecond Number) be the double of the fourth; ſo will you find the fourth Term or Number to be 6. And as in the *Rule of Three Direct*, you multiply the ſecond and third together, and divide their product for a fourth proportional Number.

2. In the *Rule of Three Inverſe*, you muſt multiply the 2d Term by the firſt (or firſt Term by the 2d) and divide the product thereof by the firſt Term, ſo the Quotient will give you the fourth Term ſought in an inverted proportion. The ſame order being obſerved in this Rule, as in the *Rule of Three Direct*, for placing and diſpoſing of the given Numbers, and after your Numbers are placed in order, that you may know whether your Queſtion be to be reſolved by the Rule Direct or Inverſe, obſerve the general Rule following.

3. When your Queſtion is ſtated, and your Numbers orderly diſpoſed, Conſider, in the firſt place, whether the fourth Term or Number ſought, ought to be more or leſs than the ſecond Term; which you may eaſily do: And if it is required to be more or greater than the 2d Term, then the leſſer extream muſt be your Diviſor; but if it require leſs, then the higheſt Extream muſt be your Diviſor in this Caſe; the firſt and third Numbers are called Extreams (in reſpect of the ſecond) and having found out your Diviſor, you may know whether your Queſtion belong to the Rule Direct or Inverſe; for if the third Term be your Diviſor, then it is *Inverſe*; but if the 1ſt Term be your Diviſor, then it is a Direct Rule. As in the following Queſtions.

Queſt. 1. If 8 Labourers can do a certain piece of Work in 12 Days, in how many Days will 16 Labourers do the ſame? *Anſwer*, in 6 Days.

Having placed the Numbers according to the ſixth Rule of the tenth Chapter, I conſider, that if 8 Men can finiſh the Work in 12 Days, 16 Men will do it in leſſer or (fewer Days than 12) therefore the biggeſt Extream muſt be the Diviſor, which is 16, and therefore it is the Rule of Three Inverſe; wherefore I multiply the firſt and 2d Numbers together, *viz.* 8 by 12, and their product is 96, which divided by 16, quotes 6 Days for the Anſwer; and in ſo many Days will 16 Labourers perform a piece of Work, when 8 Men can do it in 12 days.

```
lab.   days   lab.
8 —— 12 —— 16
        8
   ————
16) 96 (6 days
    96
    (0)
```

Facit, 6 days.

Queſt. 2. If when the Meaſure, (*viz.* a Peck) of Wheat coſt 2 *s.* the Penny-loaf weighed (according to the Standard Statute, or Law of *England*) 8 Ounces, I demand how much it will weigh when the Peck is worth 1*s.* 6*d.* according to the ſame Rate or Proportion? *Anſwer*, 10 *oz.* 23 *p.w.* 8 *gr.*

Having placed and reduced the given Numbers according to the 6th and 9th Rules of the 10th Chapter, I conſider that at 1*s.* 6*d.* *per* Peck the Penny-loaf will weigh more than at 2*s.* *per* Peck; for as the Price decreaſeth, the Weight increaſeth; and as the Price increaſeth, ſo the weight diminiſhes; wherefore becauſe the firſt Term requires more than the ſecond, the leſſer Extream muſt be the Diviſor, *viz.* 1*s.* 6*d.* or 18*d.* and having finiſhed the Work, I find the Anſwer to be 10 *oz.* 13 *p.w.* 8 *gr.* and ſo much will the Penny-Loaf weigh when the Peck of Wheat is worth 1*s.* 6*d.* according to the given Rate of 8 Ounces, when the Peck is worth 2 Shillings. The Work is plain in the following Operation.

```
 s.    oz.              s.      d.
 2     8                1       6
 12    24               12
 ---   ----            -----
 24    32               18
       6
   ----------oz. p.w. gr.
 18) 192  (10—13—8
       ..
    -------
Rem. (22)
      20
   -------- p.w.
 18) 240 (13
      18
     -- --
      60
      54
     ---
     (6)
      24
   ----------
 18 (144(8 gr
     144
   --------
     (0)
```

Queſt. 3. How many pieces of Money or Merchandize at 20 *s.* *per* piece, are to be given or receiv'd for 240 pieces, the value or price of every piece being 12 Shillings? Anſwer, 141 *l.* For if 12 *s.* require 240 pieces, then 20 *s.* will require leſs; therefore the bigger Extream muſt be the Diviſor, which is the third Number, &c. See the Work as in the Margent.

```
      s.   pcs   s.
   If 12 — 240 — 20
             12
        ----------
            480
            240
   2|0)  288|0 (144 pcs at
         ----      20s. per pc.
            2
          ----
            8
            8
          ----
             8
             8
          ----
           (0)
```

Queſt. 4. How many yards of 3 quarters broad, are required to double, or be equal in Meaſure to 30 Yards, that are 5 Quarters broad? *Anſwer*, 50 Yards. For ſay, if 5 Quarters wide require 30 Yards long, what length will 3 Quarters broad require? Here I conſider that 3 Quarters broad will require more yards than 30; for the narrower the Cloth is, the more in length will go to make equal Meaſure with a broader piece.

```
qrs.   long   qrs.
 5 —— 30 —— 5
         5
      ———
  3) 150 (50 yds
        15
      ———
       (0)
```

Queſt. 5. At the Requeſt of a Friend, I lent him 200 *l.* for 12 Months: Promiſing to do me the like Courteſy at my Neceſſity; but when I came to requeſt it of him, he could let me have but 150 *l.* now I deſire to know how long I may keep this Money to make plenary Satisfaction for my former Kindneſs to my Friend? *Anſwer*, 16 Months. I ſay, If 200 *l.* will require 12 Months, what will 150*l.* require; 150*l.* will require more Time than 12 Months, therefore the leſſer Extream, (*viz.* 150) muſt be the Diviſor, multiply and divide, and you will find the fourth inverted proportional to be 16, and ſo many Months I ought to keep the 150 *l.* for Satisfaction.

Queſt. 6. If for 24 *s.* I have 1200 *l.* Weight carried 36 Miles, how many Miles ſhall 1800 *l.* be carried for the ſame Money? *Anſwer*, 24 Miles.

Queſt. 7. If for 24 *s.* I have 1200 *l. wt.* carried 36 Miles, how many *l. wt.* ſhall I have carried 4 Miles for the ſame Money? *Anſwer*, 1800 *l.* weight.

Queſt. 8. If 100 Workmen in 12 Days finiſh a piece of Work or Service, how many Workmen are ſufficient to do the ſame in 3 Days? *Anſwer*, 400 Workmen.

Queſt. 9. A Colonel is beſieged in a Town in which are 1000 Soldiers with Proviſion of Victuals only for 3 Months, the Queſtion is, How many of his Soldiers muſt he diſmiſs, that his Victuals may laſt the remaining Soldiers 6 Months? *Anſwer*, 500 he muſt keep and diſmiſs as many.

Queſt.

Q. 10. If Wine worth 20 *l.* is ſufficient to line a Ordinary of 100 Men, when the Tun is ſold for 30 *l.* how many Men will the ſame 20*l.* worth ſuffice when the Tun is worth 24 *l.*? *Anſwer*, 125 Men.

Q. 11. How much Pluſh is ſufficient for the Cloak, which hath in it 4 yards of 7 quarters wide, when the Pluſh is but 3 quarters wide? *Anſw.* $9\frac{1}{3}$ yards of Pluſh.

Q. 12. How many yards of Canvas that is Ell-wide, will be ſufficient to line 20 yards of Say, that is 3 quarters wide? *Anſwer*, 12 yards.

Q. 13. How many yards of Matting that is 2 Foot wide, will cover a Floor that is 24 Foot long, and 20 Foot broad? *Anſwer*, 240 Foot.

Q. 14. A Regiment of Soldiers, conſiſting of 1000, are to have new Coats, and each Coat to contain two yards 2 quarters of Cloth, that is 5 quarters wide, and they are to be lined with Shalloon that is 3 quarters wide, I demand how many yards of Shalloon will line them? *Anſwer*, $16666\frac{1}{3}$ quarters, or $4166\frac{3}{4}$ yards.

Q. 15. A Meſſenger makes a Journey in 24 Days, when the Day is 12 Hours long. I deſire to know in how many Days he will go the ſame when the Day is 16 Hours long? *Anſwer*, in 18 Days.

Q. 16. *I* borrowed of my Friend, 64 *l.* for 8 Months, and he hath occaſion another time to borrow of me for 12 Months, I deſire to know how much I muſt lend to make good his former Kindneſs to me? *Anſwer*, 42*l.* 13*s.* 4*d.*

4. The general Effect of the Rule of Three Inverſe, is contained in the Definition of the ſame, that is, to find a fourth Term in a Reciprocal proportion inverted to the proportion given.

The 2d Effect is, by two pieces, or Values of two ſeveral pieces of Money and Merchandizes known, to find how many pieces of the one price is to be given for ſo many of the other. And ſo to reduce and exchange one ſort of Money or Merchandize into another. Or elſe to find the price unknown of any piece given to exchange in Reciprocal proportion.

The 3d Effect is, by two different prices of a Meaſure of Wheat bought or ſold, and the Weight of the Loaf of Bread, made anſwerable to one of the prices of the Meaſure given, to find out the Weight of the ſame Loaf anſwerable to the other price of the ſaid Meaſure given. Or elſe, by the 2 ſeveral Weights of the ſame priced Loaf, and the price of the Meaſure of Wheat anſwerable to one of thoſe Weights given, to find out the other price of the Meaſure anſwerable to the other Weight of the ſame Loaf.

The 4th Effect is, by two Lengths, and one Breadth of two Rectangular Plains known, to find out another Breadth unknown. Or by 2 Breadths and one Length given, to find out another Length unknown in an inverted Proportion.

The fifth Effect is, by double Time, and a Capital Sum of Money borrowed or lent, to find out another Capital Sum anſwerable to one of the given Times, or otherwiſe, by two Capital Sums, and a Time anſwerable to one of them given, to find out a Time anſwerable to the other Capital Sum in Reciprocal Reaſon.

The ſixth Effect is, by two different Weights of Carriage, and the diſtance of the place in Miles or in Leagues given, to find another diſtance in Miles anſwerable to the ſame price of Payment; Or otherwiſe by two diſtances in Miles, and the weight anſwerable to one of the Diſtances (being carried for a certain price) to find out the weight anſwerable to the other diſtance for the ſame price.

The 7th Effect is, by double Workmen, and the Time anſwerable to one of the Numbers of Workmen given, to find out the Time anſwerable to the other Number of Workmen, in the performance of any Work or Service. Or contrariwiſe, by double Time, and the Workmen anſwerable to one of thoſe Times given, to find out the Number of Workmen anſwerable to the other Time, in the performance of any Work or Service.

Alſo by a double price of proviſion and the Number of Men, or other Creatures, nouriſhed for a certain Time anſwerable to one of the prices of proviſions given,

ven, to find out another Number of Men or other Creatures anſwerable to the other price of the proviſion for the ſame Time. Or contrariwiſe, by two Numbers of Men or other Creatures nouriſhed, and one price of proviſion anſwerable to one of the Numbers of Creatures given, to find out the other price of the ſame proviſion anſwerable to the other Number of Creatures, both being ſuppoſed to be nouriſhed for the ſame, *&c.*

To prove the Operation of the Rule of Three Inverſe, multiply the third and 4th Terms together, and note their product; and multiply the 1ſt and 2d together, and if their product is equal to the product of the 3d and 4th, then is the Work truly wrought, but if it falleth otherwiſe, then it is erroneous.

As in the firſt Queſtion of this Chapter *16* (the 3d Number) being multiplied by *6* (the 4th Number) the Product is 96, and the product of 8 (the firſt Number) multiplied by 12 (the 2d Number) is *96*, equal to the firſt product, which proves the Work to be right.

And note, That if in Diviſion any thing remain, ſuch Remainder muſt be added to the product of the third and fourth Terms, and if the Sum be equal to the product of the firſt and ſecond (the Homogenial Terms being of one Denomination) the Work is right.

CHAP. XII.

The Double Rule of Three Direct.

WE have already delivered the Rule of Single Proportion, and we come now to lay down the Rules of plural Proportion.

1. Plural Proportion is, when more Operations in the *Rule of Three* than one are required before a Solution can be given to the Queſtion propounded. Therefore in Queſtions that require Plurality in Proportion, there are always given more than three Numbers.

2. When there are given 5 Numbers, and a ſixth is required in proportion thereunto, then this ſixth proportion is ſaid to be found out by the Double Rule of Three, as in the Queſtion following, *viz.*

If 100*l.* in 12 Months gain 6*l.* Intereſt, how much will 75*l.* gain in 9 Months?

3. Queſtions in the Double Rule of Three, may be reſolved either by 2 Single Rules of Three, or by one Single Rule of Three, compounded of the 5 given Numbers.

4. The Double Rule of Three, is either Direct, or elſe Inverſe.

5. The Double Rule of Three Direct is, when unto 5 given Numbers, a ſixth proportional may be found out by two Single Rules of Three Direct.

6. The five given Numbers in the Double Rule of Three Direct conſiſts of 2 parts, *viz.* 1. A Suppoſition, and 2dly, of a Demand; the Suppoſition is contained in the three firſt of the five given Numbers, and the Demand lies in the two laſt; as in the Example of the 2d Rule of this Chapter, *viz.* If 100*l.* in 12 Months gain 6*l.* Intereſt, what will 75*l.* gain in 9 Months? Here the Suppoſition is expreſs'd in 100, 12, and 6, for it is ſaid, if 100*l.* in 12 Months gain 6*l.* Intereſt: And the Demand lieth in 75 and 9; for it is demanded, how much 75*l.* will gain in 9 Months?

7. When your Queſtion is ſtated, the next Thing will be to diſpoſe of the given Numbers in due order and place, as a Preparative for Reſolution: which that you may do, Firſt, obſerve which of the given Numbers in the Suppoſition is of the ſame Denomination with the Number required; for that muſt be the 2d Number (in the firſt Operation) of the Single Rule of Three, and one of the other Numbers in the Suppoſition (it matters not which) muſt be the *firſt Number*, and that Number in the Demand which is of the ſame Denomination with the firſt, muſt be the third Number; which three Numbers being thus placed, will make one perfect Queſtion in the Single Rule of Three, as in the fore-mentioned Example: Firſt, I conſider, that the Number required in the Queſtion, is the Intereſt or Gain of 75*l.* therefore that Number in the Suppoſition which hath the ſame Name, (*viz.* 6 *l.*) which is the Intereſt or Gain of 100 *l.* muſt be the ſecond Number

100—*6*—75

in the firſt Operation, and either 100 or 12 (it matters not which) muſt be the firſt Number; but I will take 100, and then for the third Number I put that Number in the Demand, which hath the ſame Denomination with 100, which is 75; (for they both ſignify pounds principal) and then the Numbers will ſtand as you ſee in the Margent.

But if I had for the firſt Number put the other Number in the Suppoſition, *viz.* 12, which ſignifies 12 Months, then the 3d Number muſt have been 9, which is the Number in the Demand which hath the ſame Denomination with the firſt, *viz.* 9 Months; and then they will ſtand as in the Margent.

100—*6*—9

There yet remain two Numbers to be diſpoſed of, and thoſe are one in the Suppoſition, and another in the Demand; that which is of the Suppoſition, I place under the firſt of the three Numbers; and the other, which is the Demand, I place under the 3d Number; and then two of the Terms in the Suppoſition will ſtand (one over the other) in the firſt place, and the two Terms in the Demand, will ſtand (one over the other) in the 3d place, as in the Margent.

100—*6*—75
12 9

Or this,

12—*6*—9
100 9

8. Having diſpoſed or ordered the given Numbers, according to the laſt Rule, we may proceed to a Reſolution; and firſt I work with the 3 uppermoſt *Numbers*, which according to the firſt Diſpoſition are 100, *6* and 75; which is as much as to ſay, If 100 *l.* require *6 l.* (Intereſt) how much will 75 *l.* require? Which by the 3d Rule of the 11th Chap. I find to be Direct, and by the 7th and 8th Rules of the 10th Chapter, I find the 4th proportional Number to be 4*l.* 10*s.* ſo that by the foregoing ſingle Queſtion I have diſcovered how much Intereſt 75 *l.* will gain in 12 Months; the Operation whereof followeth on the Left-hand under the Letter A, and having diſcovered how much it will gain in 12 Months, we may by another Queſtion eaſily diſcover how much it will gain in 9 Months; for this 4th Number

er (thus found) I put in the middle between the two
weſt Numbers of the 5, after they are placed according
the 7th Rule of this Chapter, and then it will be a
Number, in another Queſtion in the *Rule of Three.*

m. *l.* *s.* *m.*
he Numbers being 12—4—10—9 the firſt and third
umbers being of one Denomination, *viz.* both Months,
d may be thus expreſs'd; If 12 Months require 4 *l.*
s. Intereſt, what will 9 Months require? And by
e 3d Rule of the 11th Chapter, I find it to be the
rect Rule, and by working according to the Directi-
ns laid down in the 7th, 8th and 9th Rules of the 10th
hapter, I find the fourth proportional Number to the
ſt ſingle Queſtion, to be 3*l.* 7*s.* 6*d.* which is the
th proportional Number to the 5 given Numbers,
d is the Anſwer to the general Queſtion. The Work
the laſt Single Queſtion is expreſs'd on the right
e of the page under the Letter B, as followeth.

```
                    100 | —6—75
             A       12 |    9           B
    l.       l.      l. |    Then ſay,
 If 100      6       75 |      m.    l.    s.    m.
            75          |  If  12    4     10    9
          ----          |           20
            30          |         ----
            42          |         90 ſhillings
          ------ l.  s. |         12
 1|00)  4|50 (4—10      |        ----
         .              |        180
                        |         90
          4             |       ------
        -----           |      1080 pence
 rem.   (50)            |          9
 Mult.   20             |  ---------12)2|0  l. s. d.
        ----            | 12)9720 (8|0 (67 (3 7 6
 1100 (10|00 (10 s.     |     ...    .
                        |     99    72 --------
                        |    ----  ------(7s.
           l.      s.   |     12    90
 Facit,    4       10   |     12    84
                        |    ----  ----
                        |    (0)   (6) d.
                        | Facit, 3l. 7s. 6d.       So
```

So that by the foregoing Operation, I conclude, th if 100 *l.* in 12 Months gains 6 *l.* Intereſt, 75 will ga 3*l.* 7*s.* 6*d.* in 9 Months after the ſame rate, the Anſwer would have been the ſame if the 5 given Numbers had been ordered according to the ſecond Method, *viz.* as you ſee in the Margent.

12—6—
100——

For firſt, I ſay, if 12 Months gain 6*l.* what will Months gain? This Queſtion I find to be *Direct* by t 3d Rule of the 11th Chapter, and by the 7th and 8 Rules of the 10th Chapter, I find the fourth propo tional Number to theſe three to be 4*l.* 10*s.*

Thus I have found out what is the Intereſt of 100 for 9 Months, and I am now to find the Intereſt of 7 for 9 Months; to effect which, I make this 4th Numb (found as before) to be my ſecond Number in the ne Queſtion, I ſay, if 100 *l.* require 4*l.* 10*s.* what wi 75*l.* require? This Queſtion, I find (by the ſaid Rule of the 11th Chapter) to be Direct, and by t ſaid 7th, 8th and 9th Rules of the 10th Chapter, find the Anſwer to be as before, *viz.* 3*l.* 7*s.* 6*d.*

The Operations of this Rule in the following Queſt ons, are purpoſely omitted, to try the Learners Cap city.

Queſt. 2. A ſecond Example in this Rule may be followeth, *viz.* A Carrier receiving 42 Shillings for t Carriage of 300 Weight 150 Miles, I demand ho much he ought to receive for the Carriage of 7 C. *qrs.* 14 *l.* 50 Miles at that rate? *Anſwer*, 35*s.* 9*d.*

Queſt. 3. A Regiment of 936 Soldiers eat up 3 Quarters of Wheat in 108 Days, I demand how ma Quarters of Wheat 11232 Soldiers will eat in 56 Da at that Rate? *Anſwer*, 1404 Quarters.

Queſt. 4. If 40 Acres of Graſs be mowed by 8 M in 7 Days, how many Acres ſhall be mowed by 24 M in 28 Days? *Anſwer*, 480 Acres.

Queſt. 5. If 48 Buſhels of Corn (or other Seed) yie 576 Buſhels in a Year, how much will 240 Buſh yield in 6 Years at that Rate; that is to ſay, if th were ſowed 240 Buſhels every one of the 6 Year *Anſwer*, 17280 Buſhels.

Queſt. 6. If 40 Shillings is the Wages of 8 Men for 5 Days, what will be the Wages of 32 Men for 24 Days? *Anſwer*, 768 Shillings, or 38*l.* 8*s.*

Queſt. 7. If 14 Horſes eat 56 Buſhels of Provender in 16 Days, how many Buſhels will 20 Horſes eat in 24 Days? *Anſwer*, 120 Buſhels.

Queſt. 8. If 8 Cannons in one Day ſpend 48 Barrels of Powder, I demand how many Barrels 24 Cannons will ſpend in 12 Days at that Rate? *Anſwer*, 1728 Barrels.

Queſt. 9. If in a Family conſiſting of 7 Perſons, there are drunk out 2 Kilderkins of Beer in 12 Days, how many Kilderkins will there be drunk out in 8 Days by another Family conſiſting of 14 Perſons? *Anſwer*, 48 Gallons, or 2 Kilderkins and 12 Gallons.

Queſt. 10. An Uſurer put 75*l.* out to receive Intereſt for the ſame, and when it had continued 9 Months, he received for Principal and Intereſt 78*l.* 7*s.* 6*d.* I demand at what Rate *per Cent. per Annum*, he received Intereſt; *Anſwer*, 6*l. per Cent. per Annum.*

CHAP. XIII.

The Double Rule of Three Inverſe.

THE *Double Rule of Three Inverſe*, is, when a Queſtion in the Double Rule of Three is reſolved by two Single Rules of Three, and one of thoſe Single Rules falls out to be Inverſe, or requires a fourth Number in Proportion Reciprocal (for both Queſtions are never Inverſe).

2. In all Queſtions of the Double Rule of Three (as well *Inverſe* as *Direct*) you are in the diſpoſing of the 5 given Numbers, to obſerve the 7th Rule of the 12th Chapter, and in reſolving of it by two Single Rules, obſerve to make choice of your Numbers for the firſt and ſecond Single Queſtions, according to the Directions given in the 8th Rule of the ſame Chapter, and in the Example following, *viz.*

Queſt. 1. If 100*l.* Principal in 12 Months gain 6*l*
Intereſt, what Principal will gain 3*l.* 7*s.* 6*d.* in 9 Months

This Queſtion is an Inverſion of the firſt Queſtion o
the 12th Chapter, and may ſerve for a Proof thereof.

In order to a Reſolution, I diſpoſe of the 5 give
Numbers according to the 9th Rule of the laſt Chapter; and being ſo diſpoſed, they will ſtand as followeth.

12 —— 100 —— 9
6 *l.* *s.* *d*
3—7—6

Or thus,

l. *s.* *d.*
6 —— 100 —— 3—7—6
12 9

Here obſerve, That according to the 8th Rule of the 12th Chapter, the firſt Queſtion, if you take it from the 5 Numbers (as they are ordered or placed firſt) will be, if 12 Months require 100l. principal, what will 7 Months require to make the ſame Intereſt? This (according to the 3d Rule of the 11th Chapter) is Inverſe, and the Anſwer will be found (by the 2d Rule of the 11th Chapter) to be 133*l.* 6*s.* 8*d.* The 2d Queſtion then will be, If 6*l.* Intereſt require 133*l.* 6*s.* 8*d.* principal; how much principal will 3*l.* 7*s.* 6*d.* require? This is a Direct Rule, and the Anſwer in a Direct Proportion, is 75 *l.* See the Work.

First I ſay,
m. l. m.
12 —— 100 —— 9
12
—— l. s. d.
9) 1200 (133—6—8
...
9 l. s. d.
—— *Fac.* 133—6—8
30
27
30
27
(3)
20
9) 60 (6 s.
54
(6)
12
9) 72 (8 d.
72
(0)

Then I ſay,

```
   l.      l.      s.    d.      l.      s.     d.
If 6 —— 133 —— 6 —— 8 —— 3 —— 7 —— 6
  240 ——   20              20
 -------  ------         ------
 1440 d.  2666             67
            12             12
       ---------         ------
          5340            140
         2666             67
       --------         -------
          32000           810 d.
            810
        --------
         320000
        256
------- ------- ------- 24|0
144|0) 259200|0 (18000|0 d. or 75 l.
        .....            ..
        144        168
       -----      -----
        1152       120
        1152       120
      ------     ------
        (0)        (0)
```

So that by the foregoing Work I find, that if 6 *l.* Intereſt be gain'd by 100*l.* in 12 Months 3*l.* 7*s.* 6*d.* will be gain'd by 75*l.* in 9 Months.

But if the Reſolution had been found out by the Numbers as they are rank'd in the ſecond place, then the ſecond Queſtion in the Single Rule would have been *Inverſe*, and the firſt Queſtion *Direct*, and the Concluſion the ſame with the firſt Method, *viz.* 75 *l.*

Queſt. 2. If a Regiment conſiſting of 936 Soldiers, can eat up 351 Quarters of Wheat in 168 Days, how many Soldiers will eat up 1404 Quarters in 56 Days at that Rate? *Anſwer*, 11232 Soldiers.

Queſt. 3. If 12 Students in 8 Weeks ſpend 48*l.* I demand how many Students will ſpend 288*l.* in 18 Weeks? *Anſwer*, 32 Students.

Q. 4. If 48 *l.* ſerve 12 Students 8 Weeks, how many Weeks will 288 *l.* ſerve 4 Students? *Anſwer*, 144 Weeks.

Q. 5. If when a Buſhel of Wheat coſt 3*s.* 4*d.* the Penny-loaf weigheth 12 Ounces, I demand the Weight of the Loaf worth 9 *d.* when the Buſhel coſt 10 *s.*? *Anſwer*, 36 Ounces.

Q. 6. If 48 Pioneers in 12 Days caſt a Trench 24 Yards long, how many Pioneers will caſt a Trench 168 Yards long in 16 Days? *Anſwer*, 252 Pioneers.

Q. 7. If 12 C. Weight being carried 100 Miles, coſt 5*l.* 12*s.* I deſire to know how many C. Weight may be carried 150 Miles for 12*l.* 12*s.* at that Rate? *Anſwer*, 18 C.

Q. 8. If when Wine is worth 30*l.* *per* Tun, 20 *l.* worth is ſufficient for the Ordinary of 100 Men, how many Men will 4*l.* worth ſuffice, when it is worth 24*l.* *per* Tun? *Anſwer*, 25 Men.

Q. 9. If 6 Men in 24 Days mow 72 Acres; in how many Days will 8 Men mow 24 Acres? *Anſwer*, in 6 Days.

Q. 10. If when the Tun of Wine is worth 30 *l.* 100 Men will be ſatisfied with 20 *l.* worth, I deſire to know what the Tun is worth when 4*l.* worth will ſatisfy 25 Men at the ſame Rate? *Anſwer*, 24*l.* *per* Tun.

CHAP. XIV.

The Rule of Three compoſed of Five Numbers.

THE Rule of Three Compos'd, is when Queſtions (wherein there are 5 Numbers given to find a 6th in proportion thereunto) are reſolved by one ſingle Rule of Three compos'd of the 5 given Numbers.

2. When Queſtions may be performed by the Double Rule of Three Direct, and it is required to reſolve them by the Rule of Three Compos'd; firſt order or rank your Numbers according to the 7th Rule of the 12th Chapter; then,

The Rule is,

Multiply the Terms or Numbers (that ſtand one ver the other in the firſt place) the one by the other, nd make their product the firſt Term in the Rule of hree Direct; then multiply the Terms that ſtand one ver the other in the third place, and place their product for the 3d Term, in the Rule of Three Direct, and ut the middle Term of the 7 uppermoſt for a ſecond erm; then having found a 4th Proportional Direct to heſe Three, this 4th Proportional ſo found ſhall be he Anſwer required.

So the firſt Queſtion of the 12th Chapter being propos'd, *viz.* If 100*l.* in 12 Months gain 6*l.* Intereſt, what will 75*l.* gain in 9 Months? The Numbers being rank'd (or plac'd) as is there directed and done.

Then I multiply the two firſt Terms, 100 and 12, the one by the other, and their product is 1200 (for the firſt Term) then I multiply the two laſt Terms 75 and 9 together, and their product is 675 for the third Term. Then I ſay, as 1200 is to 6, ſo is 675 to the Anſwer, which by the Rule of Three Direct, will be found to be 3*l.* 7*s.* 6*d.* as was before found.

3. But if the Queſtion be to be anſwered by the Double Rule of Three Inverſe, then (having placed the 5 given Terms as before) multiply the lowermoſt Term of the firſt place, by the uppermoſt Term of the third place, and put the product for the firſt Term; then multiply the Term of the third place, and put the product for the third Term, and the ſecond Term of the three higheſt Numbers for the middle Term to thoſe two; then if the Inverſe proportion is found in the uppermoſt three Numbers, the fourth proportional Direct to theſe three ſhall be the Anſwer. So the firſt Queſtion to the 13th Chapter being ſtated, *viz.* If 100*l.* principal in 12 Months gain 6*l.* Intereſt, what principal will gain 3*l.* 7*s.* 6*d.* in 9 Months? State the Numbers as is there directed in the firſt Order, *viz.*

m. l. m.
12——100——9
l. l. s. d.
6 8--7--6

Then reduce the *6l.* and *3l. 7s. 6d.* into Pence, the *6l.* is 1440 *d.* and *3l. 7s. 6d.* is 801*d.* then multiply 1440 by 9, the product is 12960 for the firſt Term in the Rule of Three Direct, and multiply 810 by 12, the product is 9720, for the third Term; then I ſay, as 12960 is to 139*l.* ſo is 9720 to the Anſwer, *viz.* 75*l.* as before. But if the Terms had been placed after the ſecond Order, *viz.*

l. l. l. s. d.
6——100——3——7——6
m. m.
12 9

Then the *Inverſe Proportion* is found in the loweſt *Numbers*, and having compoſed the Numbers for a *Single Rule of Three*, as in the ſecond Rule foregoing; then the Anſwer muſt be found by a *Single Rule of Three Inverſe*; for here it falls out to multiply 810 by 12 for the firſt Number, and 1440 by 9 for the third Number; and then you muſt ſay, As 9720 is to 100*l.* ſo is 12960 to the [illegible] which by *Inverſe Proportion* will be found, [illegible]s before.

The Queſtions in the [illegible]h and 13th Chapters may ſerve for thy farther [illegible]ience.

CHAP. XV.

Single Fellowſhip.

FELLOWSHIP, is that Rule of plural proportion, whereby we Balance [illegible]compts depending between divers Perſons having put together a General Stock, ſo that they may every Man have his proportional part of Gain, or ſuſtain his proportional part of Loſs.

2. The Rule of Fellowſhip, is either Single, or it is Double.

3. The Single Rule is, when the Stocks propounded are ſingle Numbers, without any reſpect or relation to Time, each Partner continuing his Money in Stock for the ſame Time.

4. In the Single Rule of Fellowſhip, the proportion is, as the whole Stock of all the Partners is in proportion to the total Gain or Loſs, ſo is each Man's particular Share in the Stock, to his particular Share in the Gain or Loſs. Therefore take the Total of all the Stocks for the firſt Term in the Rule of Three, and the whole Gain or Loſs for the ſecond Term, and the particular Stock of any one of the Partners for the 3d Term, then multiply and divide according to the 7th Rule of the 9th Chapter, and the fourth proportional Number is the particular Loſs or Gain of him whoſe Stock you made your ſecond Number, wherefore repeat the Rule of Three as often as there are particular Stocks or Partners in the Queſtion, and the fourth Terms produced upon the ſeveral Operations, are the reſpective Gain or Loſs of thoſe particular Stocks given, as in the Examples following.

Q. 1. Two Perſons, *viz.* A and B bought a Tun of Wine for 20*l.* of which A paid 12*l.* and B paid 8*l.* and they gained in the Sale thereof 5*l.* now I demand each Man's Share in the Gains according to his Stock?

Firſt, I find the Sum of all their Stocks, by adding them together, *viz.* 12*l.* and 8*l.* which are 20*l.* then according to this Rule, I ſay firſt, if 20*l.* (the Sum of their Stock) require 5 the total Gain, how much will 12*l.* (the Stock of A) require?

$$\begin{array}{r} 12 \\ 8 \\ \hline 20\text{ l.} \end{array}$$

Multiply and divide by the 7th Rule of the 9th Chapter, and the Anſwer is 3*l.* for the Share of A in the Gains; then again I ſay, If 20*l.* require 5*l.* what will 8*l.* require? The Anſwer is 2*l.* which is the Gain of B. So I conclude that the Share of A in the Gain is 3*l.* and the Share of B in the Gain is 2*l.* which in all is 5*l.*

l. l. l.
If 20 —— 5 —— 12
[illegible]
20) 60 (3 l.
60
(0)

l. l. l.
If 20 —— 5 —— 8
8
20) 40 (2 l.

Q. 2. Three Merchants, *viz.* A, B and C, enter upon a joint Adventure, A put into the common Stock 78 *l.* B put in 117*l.* and C put in 234*l.* and they find (when they made up their Accompts) that they have gain'd in all 264*l.* now I deſire to know each Man's particular Share in the Gain.

Firſt, I add their particular Stocks together; and their Sum is 429 *l.* then ſay, If 429 *l.* gain 264*l.* what will 78*l.* gain? and what 117*l.* and what will 234*l.* (the Stocks of A, B and C) gain? Work by three ſeveral *Rules of Three*, and you will find that

l.
78
117
234
Sum 429

The Gain of A, B, C is 48, 72, 144

The Gain of		is	
	A		48
	B		72
	C		144
		Sum	264

Queſt. 3. Four Partners, *viz.* A, B, C and D, between them built a Ship which coſt 1730*l.* of which A paid 346*l.* B 519*l.* C 692*l.* and D 173*l.* and her Freight for a certain Voyage is 370*l.* which is due to the Owners or Builders. I demand each Man's Share therein according to his Charge in Building her.

Anſwer,

A 74
B 111
C 148
D 37

Sum 370

Queſt. 4. A, B and C enter Partnerſhip for a certain Time, A put into the Common-Stock 364*l.* B put in 432*l.* C put in 5 *l.* and they gain'd 867*l.* Now I demand each Man's Share in the Gain, proportionable to his Stock?

Anſwer,

	l.	s.	d.
A	234	09	3 $\frac{354}{1346}$
B	310	09	5 $\frac{63}{1346}$
C	322	01	3 $\frac{930}{1346}$
Sum	867	00	0

5. To prove the *Rule of Single Fellowſhip*, add each Man's particular Gain or Loſs together, and if the Total Sum is equal to the general Gain or Loſs, then is the Work rightly performed; but otherwiſe it is erroneous. *Example*: In the firſt Queſtion of this Chapter, the Anſwer was, That the Gain of A was 3*l.* and the Gain of B 2*l.* which added together makes 5*l.* equal to the total Gain given.

The Proof of the Rule of Single Fellowſhip.

If in finding out the particular Shares of the ſeveral Partners, any thing remain after Diviſion is ended, ſuch Remainders muſt be added together, (they being all Fractions of the ſame Denominations) and their Sum divided by the common Diviſor in each Queſtion, (*viz.* the total Stock) and the Quotient add to the particular Gains, and then if the Total Sum is equal to the Total Gain, the Work is right, otherwiſe not.

As in the 4th Queſtion, the Remainders were 354, 63 and 930, which added together made 1346, which divided by 1346, (the Sum of their Stocks) the Quotient is 1*d.* which I add to the Pence, *&c.* and the Sum of their Share is 867*l.* equal to the Total Gain, wherefore I conclude the Work is right.

CHAP.

CHAP. XVI.

Double Fellowſhip.

1. DOUBLE Fellowſhip, is when ſeveral Perſons enter into Partnerſhip for unequal Time; that is, when every Man's particular Stock hath Relation to a particular Time.

2. In the *Double Rule of Fellowſhip*, multiply each particular Stock by its reſpective Time, and having added the ſeveral products together, make their Sum the firſt Number (or Term in the Rule of Three, and the Total Gain or Loſs the 2d Number, and the Product of any one's particular Stock by his Time, the third Term) and the 4th Number in proportion thereunto is his particular Gain or Loſs, whoſe product of Stock and Time is your third Number.

Then repeat (as in *Single Fellowſhip*) the *Rule of Three*, as often as there are products (or partners) and the 4 Terms thereby invented, are the Numbers required.

Example.

Queſt. 1. A and B enter Partnerſhip ; A put in 40*l.* for 3 Months, B put in 75*l.* for 4 Months, and they gain'd 70*l.* now I demand each Man's Share in the Gain, proportional to his Stock and Time? *Anſwer*, A 26*l.* B 50*l.*

To reſolve this Queſtion, I firſt multiply the Stock of A, (*viz.* 40*l.*) by its Time (3 Months) and the product is 120 ; then I multiply the Stock of B by its Time, *viz.* 75*l.* by 4) and it produceth 300, which I add to the Product of A, his Stock and Time, and the Sum is 420. Then by the *Rule of Three Direct*, I ſay, As 420 (the Sum of the product, is to 70, the Total Gain) ſo is 120 (the Product of A his Stock and Time) to 20*l.* (the Share of A in the Gains). Then I ſay again, As 420 is to 70, ſo is 300 to 50 *l.* (the Share of B in the

l.	l.
40	75
3	4
A 120	B 300
	120
	Sum 420

the Gains.) And ſo much ought each to have for his Share.

Queſt. 2. A, B and C make a Stock for 12 Moths, A put in at firſt 364*l.* and 4 Months after that he put in 40*l.* B put in at firſt 408*l.* & at the end of 7 Months he took out 86*l.* C put in at firſt 148*l.* and 3 Months after he put in 86*l.* more, and 5 Months after that he put in 100*l.* more, and at the end of 12 Months their Gain is found to be 1436*l.* I deſire to know each Man's Share in the Gains, according to his Stock and Time?

Firſt, I conſider that the whole Time of their Partnerſhip is 12 Months. Then I proceed to find out the ſeveral Products, or Stock and Time as followeth:

A had at firſt 364*l.* for 4 Months, wherefore their product is — — — —	1456
Then he put in 40*l.* which with the firſt Sum makes 404*l.* which continued the Remainder of the Time, *viz.* 8 Months, and their product is—	3233
The Sum of the Products of the Stock and Time of A is — — — — — —	4688
B had 408*l.* in 7 Months, whoſe product is—	2856
And then took out 86*l.* therefore he left in Stock 322*l.* which continued the reſt of the Time, *viz.* 5 Months, whoſe product is— —	1610
The Sum of the Products of the Stock and Time of B is — — — — —	4466
C put in 148*l.* for 3 Months, whoſe product being multiplied is — — — — —	444
Then he put in 86*l.* which added to the firſt (*viz.* 148*l.*) makes 234*l.* which lay in Stock 5 Months, their product is — — —	1170
Then he put in 100*l.* more, ſo then he had in Stock 334*l.* which continued the Remainder of the Time, 4 Months, which multiplied together, produce — — — — —	1336
The Sum of the product of the Money and Time of C is — — — — — —	2950
B	4466
A	4688
The Total Sum of all the product is — —	12104

Then I ſay, as 12104 is to 1426 (the total Gain) ſo is 2950 to the Share of A in the total Gain, *&c.* go on as in the foregoing Examples, and you will find their Shares in the Gain to be as followeth, *viz.*

Anſwer,

The Share of	A	is	556—03—6$\frac{6192}{12104}$
	B		529—16—9$\frac{1496}{12104}$
	C		349—19—8$\frac{416}{12104}$
			1436 00—0

Queſt. 3. Three Graſiers, A, B and C, take a piece of Ground for 46*l.* 10*s.* in which a put 12 Oxen for 8 Months, B put in 16 Oxen for 5 Months, and C put 18 Oxen for 4 Months; now the Queſtion is, what each Man ſhall pay of the 46*l.* 10*s.* for his Share in that Charge.

Anſwer,

		l	s.
A	ſhall pay	18	00
B		15	00
C		13	10
		46	10

3. The Proof of this Rule is the ſame with that of *Single Fellowſhip,* laid down in the 5th Rule of the 15th Chapter; and Note, that

If a Loſs be ſuſtained inſtead of Gain among Partners, every Man's Share to be born in the Loſs is to be found after the ſame Method as their Gain, whether their Stocks be for equal or unequal Time.

CHAP. XVII.

Alligation Medial.

1. THE Rule of Alligation is that Rule in Plural Proportion by which we reſolve Queſtions, wherein is a Compoſition or Mixture of divers Simples, as alſo it is uſeful in Compoſition of Medicines both for Quantity, Quality or Price. And its Species are two, *viz.* Medial and Alternate.

2. Alligation Medial, is, when having the ſeveral uantities and Prices of ſeveral Simples propounded, e diſcover the mean Price or Rate of any Quantity of he Mixture compounded of thoſe Simples, and the roportion is,

As the Sum of the Simples to be mingled is to the otal Value of all the Simples, ſo is any Part or Quantity of the Compoſition or Mixture to its mean Rate or rice.

Queſt. 1. A Farmer mingled 20 Buſhels of Wheat at 5*s.* *per* Buſhel, and 36 Buſhels of Rye at 3*s* *per* Buſhel, with 40 Buſhels of Barley at 2*s.* *per* Buſhel; now I deſire to know what one Buſhel of that Mixture is worth?

To reſolve this Queſtion, add together the given Quantities, and their Values, which is 96 Buſhels, whoſe Total Value is 14*l.* 8*s.* as appeareth by the Work following; For,

Buſhels	l. s.
20 *of Wheat at* 5s. per *Buſhel, is*	5—0
36 *of Rye at* 3s. per *Buſhel, is*	5—8
40 *of Barley at* 2s. per *Buſhel, is*	4—0
The Sum of their given Quantities, is } 96, *and their Value is,*	14—8

Then ſay, by the *Rule of Three Direct*, if 96 Buſhels coſt (or is worth) 14*l.* 8*s.* what is one Buſhel worth?

bush. l. s. bush.
96——14——8——1
20

96) 288 (3s.

288 *Facit*, 3 s. per *Buſhel.*
(0)

Queſt. 2. A Vintner mingleth 15 Gallons of Canary at 8 *s.* *per* Gallon, with 20 Gallons of Malaga, at 7*s.* 4*d.* *per* Gallon, with 10 Gallons of Malaga, at 6*s.* 0*d.*

per Gallon, and 24 Gallons of White-wine at 4*s. per* Gallon; now I demand what a Gallon of this Mixture is worth? Work as in the laſt Queſtion, and you will find the Anſwer to be 6*s.* 2*d.* 2 *qrs.* $\frac{46}{69}$.

Queſt 3. A Grocer hath mingled 3 *C.* of Sugar at 56*s. per C.* with 3 *C.* of Sugar at 3*l.* 14*s.* 8*d. per C.* and with 6 *C.* at 1*l.* 17*s.* 4*d. per C.* I deſire to know the price of a *C.* weight of that Mixture?

Anſwer, 2*l.* 13*s.* 1*d.* $\frac{7}{13}$

The Proof of Allig. Medial.

3. The proof of this Operation, is by the price of any quantity of the Mixture to find out the total Value of the whole Compoſition, and if it is equal to the Total Value of the ſeveral Simples, the Work is right; otherwiſe not. As in the firſt *Example*, the Anſwer to the Queſtion was, That 3*s.* is the price of one Buſhel, wherefore I ſay, by the *Rule of Proportion*, If one Buſhel be 3*s.* what is 96 Buſhels? *Anſwer*, 14*l.* 8*s.* which is the total Value of the ſeveral Simples: Wherefore the Work is right.

CHAP. XVIII.

Alligation Alternate.

1. ALLIGATION ALTERNATE is, when there are given the particular prices of ſeveral Simples, and thereby we diſcover ſuch quantities of thoſe Simples, as being mingled together, ſhall bear a certain Rate propounded.

2. When ſuch a Queſtion is ſtated, place the given prices of the Simples one over the other, and the propounded price of the Compoſition againſt them in ſuch ſort that it may repreſent a Root, and they as ſo many Branches ſpringing from it, as in the following *Example*.

Queſt. 1. A certain Farmer is deſirous to mix 20 Buſhels of Wheat at 5*s.* or 60*d. per* Buſhel, with Rye at 3*s.* or 3*s.* 6*d. per* Buſhel, and with Barley at 2*s.* or 24*d.* *per*

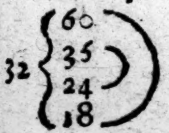
per Buſhel, and Oats at 1*s.* 6*d. per* Buſhel, and deſireth to mix ſuch a Quantity of Rye, Barley, and Oats with the 20 Buſhels of Wheat, as that the whole Compoſition may be worth 2*s.* 8*d.* or 32*d. per* Buſhel.

The prices of the Simples being placed according to the laſt Rule (with the price of the Compoſition propounded as a Root to them) will ſtand as followeth.

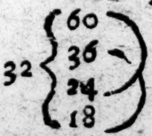
$$32\left\{\begin{array}{l}60\ \textit{Pence}\\36\\24\\18\end{array}\right.$$

3. Having thus placed the given Numbers, you are to link the ſeveral Rates of the Simples one to the other, by certain Arches, in ſuch ſort that one that is leſſer than the mean Rate, may be coupled to another that is greater than the mean Rate; ſo the Queſtion laſt propounded will ſtand

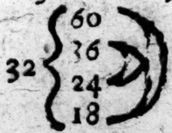
1. *Thus,*



2. *Or thus,*

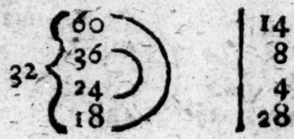


3. *Or thus,*



4. Then take the Difference between the Root and the ſeveral Branches, and place the Difference of each againſt the Number or Branch with which it is coupled or linked, and having taken all the Differences and placed them as aforeſaid, then thoſe Differences ſo placed, will ſhew you the Number of each Simple to be taken to make a Compoſition to bear the mean Rate propounded.

So the Branches of the laſt Queſtion being linked together, as in the firſt Manner, I ſay, the Difference between 32 and 60 is 28, which I put againſt 18, becauſe 60 is linked with 18, then the Difference between 32 and 36 is 4, which I put



put againſt 24, becauſe 36 is link'd or coupled with 24, then I ſay, the Difference between 32 and 24 is 8, which I place againſt 36 (for the Reaſon aforeſaid) when I ſay, the Difference between 32 and 18 is 14, which I place againſt 60; and then the Work will ſtand as you ſee in the Margent.

So I conclude that a Compoſition made of 14 Buſhels of Wheat at 60*d. per* Buſhel, and 8 Buſhels of Rye at 36*d. per* Buſhel, and 4 Buſhels of Barley at 24*d. per* Buſhel, and 28 Buſhels of Oats at 18*d. per* Buſhel, will bear the mean price of 32 *d.* or 2 *s.* 8 *d. per* Buſhel. And here obſerve, That in the Compoſition there is but 14 Buſhels of Wheat; but I would mingle 20 Buſhels, and this Kind, (or rather Caſe) of *Alligation Alternate*, (*viz*) when there is given a certain Quantity of one of the Simples, and the Quantities of the reſt ſought to mingle with this given Quantity, (that the whole may bear a Price propounded) is call'd *Alternation Partial*.

And the proportion to find out the ſeveral Quantities to be mingled with the given Quantity, is thus:

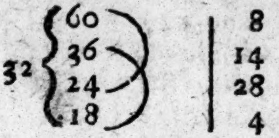
As the Difference annexed to the Branch, that is the Value of an Integer of the given Quantity is to the other particular Differences, ſo is the Quantity given to the ſeveral Quantities required.

So here, to find out how much Rye, Barley, and Oats, muſt be mingled with the 20 Buſhels of Wheat, I ſay, by the *Single Rule of Three Direct*, if 14 Buſhels of Wheat require 8 Buſhels of Rye, what will 20 Buſhels of Wheat require? *Anſwer*, $11\frac{6}{14}$ Buſhels of Rye.

Again, If 14 Buſhels of Wheat require 4 Buſhels of Barley, what will 20 Buſhels of Wheat require? *Anſw.* $5\frac{10}{14}$ Buſhels of Barley. Again, I ſay, If 14 Buſhels of Wheat require 28 Buſhels of Oats, what will 20 Buſhels of Wheat require? *Anſwer*, 40 Buſhels of Oats.

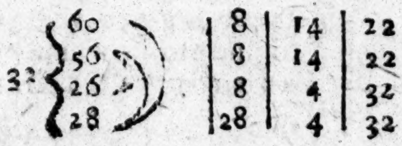
And now I ſay, that 20 Buſhels of Wheat mingled with $11\frac{6}{14}$ Buſhels of Rye, and $5\frac{10}{14}$ Buſhels of Barley, and 40 Buſhels of Oats, each bearing the Rate as aforeſaid, will make a Compoſition or Heap of Corn, that may yield 32*d. per* Buſhel.

But if the Branches had been coupled according to he ſecond Order or Manner, the Differences would ave been thus placed, *viz* the Difference between 32 and 60 s 28, which I ſet againſt 24 because 60 is linked thereto; and he Differences between 32 and 6 is 4, which I ſet againſt 18, nd the Difference between 32 and 24 is 8, which I ſet gainſt 60; then the Difference between 32 and 18 is 4, which I ſet againſt his Yoke fellow 36, and then conclude, that if you mix 8 Buſhels of Wheat with 14 Buſhels of Rye, 28 Buſhels of Barley, and 4 Buſhels of Oats, each bearing the aforeſaid Prices, the whole Mixture may be ſold for 32*d.* *per* Buſhel, as by the Work in the Margent.



You ſee by this Work we have found how many Buſhels of Rye, Barley and Oats, ought to be mixed with 8 Buſhels of Wheat, and to find out how many of each ought to be mixed with 20 Buſhels of Wheat, I ſay, as 1 is to 14, ſo is 20 to 35 Buſhels of Rye. As 8 is to 28, ſo is 20 to 70 Buſhels of Barley. As 8 is to 4, ſo is 20 to 10 Buſhels of Oats, whereby I conclude, that if to 20 Buſhels of Wheat I put 35 Buſhels of Rye, 70 Buſhels of Barley, and 10 Buſhels of Oats, bearing each the aforeſaid Price *per* Buſhel, that then a Buſhel of this Mixture will be worth 32*d.* or 2*s.* 8*d.*

And if the Branches had been linked as you ſee in the 3d place where each Branch bigger than the Root is link'd to two that are leſſer than the Root, then in this caſe you muſt have placed the ſeveral Differences between the Root and Branches, againſt thoſe two with which each is coupled, as firſt, the Difference between 32 and 60 is 28, which I ſet againſt 24 and 18, becauſe it is coupled



with them both, then the Difference between 32 and 36 is 4, which I ſet likewiſe againſt 24 and 18, becauſe 36 is linked to them both, then the Difference between 32 and 24 is 8, which I put againſt 60 and 36, becauſe 24 is linked to them both, then the Difference between 32 and 18 is 14, which I put againſt 60 and 36, the Yoke-fellow of 18.

Laſtly, I draw a Line behind the Differences, and add the Differences which ſtand againſt each Branch, and put the Sum behind the ſaid Line againſt its proper Branch, as you ſee in the Margent.

And now by this Work, I find that 22 Buſhels of Wheat mingled with 22 Buſhels of Rye, and 32 Buſhels of Barley, and 32 Buſhels of Oats, each bearing the ſaid price, will make a Mixture bearing the mean rate of 32*d. per* Buſhel.

And to find how much of each of the reſt muſt be mingled with 20 Buſhels of Wheat, I ſay,

As 22 is to 22, ſo is 20 to 20 Buſhels of Rye. As 22 is to 32, ſo is 20 to $29\frac{2}{22}$ Buſhels of Barley. As 22 is to 32, ſo is 20 to $29\frac{2}{22}$ Buſhels of Oats.

Whereby you ſee the Queſtions of *Alligation Alternate* will admit of more true Anſwers than one; for we have found 3 ſeveral Anſwers to this 1ſt Queſtion.

The Proof of Alternation Partial.

Queſtions of *Alternation Partial* are proved the ſame Way with Queſtions in *Alligation Medial*, which you may ſee in the 3d Rule of the 17th Chapter.

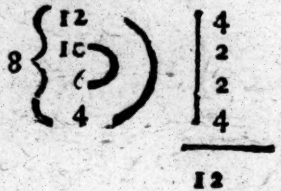
Queſt. 2. A Grocer hath 4 ſorts of Sugar, *viz.* of 12 *d. per l.* of 10 *d. per l.* of 6*d. per l.* and of 4 *d. per l.* and would have a Compoſition worth 8 *d. per l.* the whole Quantity whereof ſhould contain 144*l.* made of theſe four ſorts, I demand how much of each he muſt take.

Queſtions of this Nature are reſolved by that part of *Alligation Alternate*, called by Arithmeticians, *Alternation Total*, *viz.* where there is given the Sum and prices of ſeveral Simples to find out how much of each Simple ought to be taken to make the ſaid Sum or

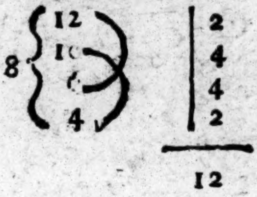
Quantity, ſo that I may bear a certain Rate propounded.

To reſolve this Queſtion, I place the ſeveral prices of the Simples and mean Rate propounded, and link them together, as is directed in the 2d and 3d Rules of this Chapter, and place the Differences between the Root and Branches, according to the 4th Rule of this Chapter, which will then ſtand one of theſe 3 Ways, *viz.*

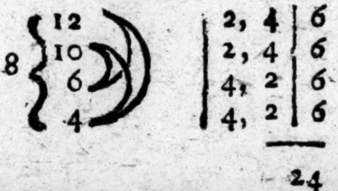
First.



Second.



Third.



5. Then add the ſeveral Differences together, which I have done, and the Sums of the firſt and ſecond Order are 12*l.* and of the 3d 24*l.* as you may ſee above. But it is required that there ſhould be 144*l.* of the Compoſition, therefore to find the Quantity of each Simple to make the whole Compoſition 144*l.* Obſerve this general Rule, *viz.*

As the Sum of the Differences is to the ſeveral Differences, ſo is the total Quantity of the Compoſition to the Quantity of each Simple.

So to find how much of each ſort of Sugar I ought to take to make 144 *l.* at 8 *d.* *per l.*

As 12 is to 4, ſo is 144 to 48*l.* at 12*d.* *per l.*
As 12 is to 2, ſo is 144 to 24*l.* at 10*d.* *per l.*
As 12 is to 2, ſo is 144 to 24*l.* at 6*d.* *per l.*
As 12 is to 4, ſo is 144 to 48*l.* at 4*d.* *per l.*

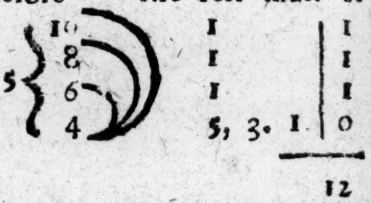
Whereby I find that 48*l.* at 12*d.* *per l.* and 24*l.* a 10*d.* *per l.* and 24*l.* at 6*d.* *per l.* and 48*l.* at 4*d.* *per l* will make a Compoſition of Sugar containing 144*l* worth 8*d.* *per l.*

But as the Branches are linked in the 2d Order, th Anſwer will be 24*l.* at 12*d.* *per l.* and 48*l.* at 10*d.* *pe l.* and 48*l.* at 6*d* *per l.* and 24*l* at 4*d.* *per l.* to make the ſaid Quantity, and to bear the ſaid price.

And if you had work'd as the Branches are linked after the third Order, then you would have found the Quantity of 36*l.* of each.

Queſt. 3. A Vintner hath 4 ſorts of Wine, *viz.* Canary at 10*s.* *per* Gallon, Malaga at 8*s.* *per* Gallon, Rheniſh-wine at 6*s.* *per* Gallon, and White wine at 4*s.* *per* Gallon, and he is minded to make a Compoſition of them all of 60 Gallons, that may be worth 5*s.* *per* Gallon, I deſire to know how much of each he muſt have?

The Number of Terms being rank'd according to the ſecond Rule of this Chapter, the Branches will be link'd as followeth; but will admit of no other Manner of coupling, becauſe there is but one Branch that is leſſer than the Root; therefore all the reſt muſt be link'd unto it; and the Differences between the Root and the three firſt Branches, *viz.* 10, 8, and 6, which are 5, 3, and 1 muſt be ſet againſt 4, becauſe they are coupled with it, and the Difference between the Root, (*viz.*) 5 and 4, which is 1, muſt be ſet againſt the 3 other, becauſe it is link'd to them all; ſo I find 1 Gallon of Canary, 1 Gallon of Malaga, 1 Gallon of Rheniſh-wine, and 9 Gallons of White-wine, prized as above, being mingled together, will be worth 5*s.* *per* Gal. the Sum being 12 Gallons, but there muſt be 60 Gallons; wherefore I ſay,



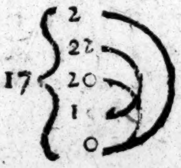
As 12 is to 1, ſo is 60 to 5 Gallons of Canary.
As 12 is to 1, ſo is 60 to 5 Gallons of Malaga.
As 12 is to 1, ſo is 60 to 5 Gallons of Rheniſh.
As 12 is to 9, ſo is 60 to 45 Gal. of White-wine.

ſo that 5 Gallons of Canary, 5 Gallons of Malaga, 5 Gallons of Rheniſh, and 45 Gallons of White wine, mingled together, will be in all 60 Gallons, worth 5*s.* *per* Gallon, which was required.

Queſt. 4. A Goldſmith hath Gold of 4 ſeveral ſorts of Fineneſs, *viz.* of 24 Carects fine, and of 22 Carects fine, of 20 Carects fine, and of 15 Careets fine. And he would mingle ſo much of each with Alloy, that the whole Maſs of 28 Ounces of Gold ſo mingled, may bear 17 Carects fine. I demand how much of each he muſt take? The 2d and 3d Rules of this Chapter being obſerved; (or inſtead of the Alloy I put 0, becauſe it bears no Fineneſs, but it makes a Branch in the Operation) the Terms may be alligated, and the Differences added by any of theſe 4 ways following, *viz.*

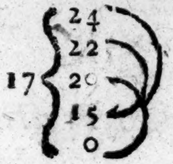
Read Chap. 2. *Dif.* 2. *of this Book.*

Firſt thus,



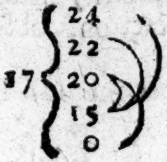
2	17	27
22	2	2
20	1, 17	19
1	5, 3	8
0	7, 3	90
	Sum	56

Secondly thus,



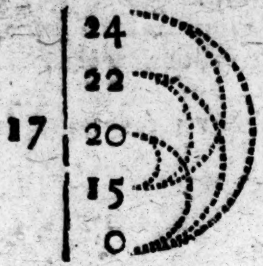
24	2	2
22	17	17
20	2,17	19
15	7,3	10
0	5,3	8
	Sum	56

Thirdly thus,



24	3,	2
22	2,	2
20	2, 17	19
15	7,5,3	15
0	3,	3
	Sum	41

Fourthly thus.



2, 17,	19
2, 17,	19
2, 17,	19
7, 5, 3,	15
7, 5, 3,	15
Sum	87

More Ways may be given for the alligating or linking of the Terms in this Queſtion, but theſe, if well practiſed, are ſufficient for underſtanding the Rules of *Alligation.*

The Proof of Alternation Total

In Queſtions of Alternation Total, the Anſwer is given true when the Sum of each of the Quantities of Simples found, agrees with the Sum or Quantity propounded, as in the laſt Queſtion the Anſwer was 8 *oz.* 10 *p. w.* of 24 Carects fine, 10 *oz.* of 22 Carects fine, 9 *oz.* 10 *p. w.* of 20 Carects fine, 4 of 15 Carects fine, and 5 *oz.* of Alloy, which added together makes 28 *oz.* the quantity propounded.

CHAP. XIX.

Reduction of Vulgar Fractions.

1. WHAT a Vulgar Fraction is, hath been already ſhewed, in the 1ſt Chapter of this Book, which I refer the Reader to look cautiouſly into.

2. To reduce a Vulgar Fraction, obſerve carefully theſe 8 following Rules.

1. To reduce a Mixt Number into an Improper Fraction.

2. To reduce a Whole Number into an Improper Fraction.

3. To reduce an improper Fraction into its equivalent Whole, (or Mixt) Number.

4. To reduce a Fraction into the loweſt Terms equi- alent to the Fraction given.

5. To find the value of a Fraction in the known arts of a Coyn, Weight, Meaſure, *&c.*

6. To reduce a Compound Fraction to a Simple one f the ſame value.

7. To reduce divers Fractions having unequal Deno- ominators, to Fractions of the ſame Value, having n equal Denominator.

8. To reduce a Fraction of one Denomination to a- nother of the ſame Value.

I. *To reduce a mixt Number to an Improper Fraction.*

The Rule is, *Vide Chap.* 1. *Defin.* 31.

Multiply the Integer part (or whole *Number*) by the Denominator of the Fraction, and to the product add he Numerator, and that Sum place over the Denomi- ator for a new Numerator, ſo this new Fraction ſhall e equal to the next Number given. As for *Example.*

1. Reduce 18$\frac{3}{7}$ into an improper Fraction, multiply he whole Number 18 by 7 the Denominator, and to he product add the Numerator 3, the Sum is 129, hich put over the Denominator 7, and it makes $\frac{129}{7}$, or the Anſwer as followeth.

18$\frac{3}{7}$
7

129

facit $\frac{129}{7}$

2. Reduce 183$\frac{5}{12}$ to an improper Fraction *facit* $\frac{2201}{12}$

3. Reduce 50$\frac{13}{21}$ to an improper Fraction *facit* $\frac{1189}{212}$.

II. *To reduce a Whole Number into an Improper Fractio*

The Rule is,

Vide Chap. 1. Defin. Multiply the given Number by the i tended Denominator, and place the produ for the Numerator over it. As for *E ample.*

1. Let it be required to reduce 15 into a Fractio whoſe Denominator ſhall be 12. To effect which, I multiply 15 by the intended Denominator (12) the Product is 180, which I place over 12 as a Numerator, and it makes $\frac{180}{12}$ which is equal to 15 as was required; as *per* Margent.

facit, $\frac{180}{12}$

2. Reduce 36 into an Improper Fraction, whoſe D nominator ſhall be 26 *Facit*, $\frac{936}{26}$.

3. Reduce 135 into an Improper Fraction, wh Denominator ſhall be 16 *Facit*, $\frac{2160}{16}$.

III. *To reduce an Improper Fraction into its Equiva Whole or Mixt Number.*

The Rule is,

Divide the Numerator by the Denominator, and Quotient is the Whole Number equal to the Fracti and if any thing remain, put it for a Numerator o the Diviſor. *Example.*

1. Reduce $\frac{436}{8}$ into its equivalent mixt Num Divide the Numerator 346 by the Denominator 8, the Quotient is 34, and 4 remains, which put fo Numerator over the Diviſor 8, the Anſwer is $54\frac{4}{8}$ followeth.

8) 436 (54
40
36 *Facit*, $54\frac{4}{8}$.
32
(4)

2. Re

2. Reduce $\frac{3476}{15}$ to a mixt Number, *facit* $231\frac{11}{15}$.
3. Reduce $\frac{25476}{136}$ to a mixt Number, *facit* $114\frac{70}{135}$.

IV. *To reduce a Fraction into its loweſt Terms equivalent to the Fraction given.*

The Rule is,

1. If the Numerator and Denominator are even Numbers, take half the one and half of the other as often as may be, and when either of them falls out to be an odd Number, then divide them by any Number that you can diſcover will divide both Numerator and Denominator without any Remainder; and when you have thus proceeded as low as you can reduce them, then this new Fraction ſo found out, ſhall be the Fraction you deſire, and will be in value equal to the given Fraction.

Example.

1. Let it be required to reduce $\frac{192}{336}$ into its loweſt Terms. Firſt I take the half of the Numerator 192, and it is *96*, then half of the Denominator, and it is 168, ſo that now it is brought to $\frac{96}{168}$, and next to $\frac{48}{84}$, and by halfing ſtill, to $\frac{24}{42}$ and their half is $\frac{12}{21}$, and now I can no longer half it becauſe 21 is an odd Number, wherefore I try to divide them by 3, 4, 5, 6, *&c.* and I find 3 divides them both without any Remainder, and brings them to $\frac{4}{7}$, as *per* Margent.

192	96	48	24	12	44
336	168	84	42	21	17

So I conclude $\frac{4}{7}$ thus found, to be equal in value to the given Fractions $\frac{192}{338}$.

2. What is $\frac{1036}{1184}$ in its loweſt Terms? *Anſ.* $\frac{7}{8}$.
3. What is $\frac{1342}{1586}$ in its loweſt Terms? *Anſ.* $\frac{11}{13}$.

The beſt way to reduce a Fraction into its loweſt Terms, is, by finding a common Meaſure, *viz.* the greateſt Number that will divide the Numerator and Denominator without any Remainder, and by that means reduce a Fraction to its loweſt Terms at the firſt Work; and to find out this common Meaſure, divide the Denominator by the Numerator, and if any thing remains, divide your Diviſor thereby; & if any thing yet remain,

then divide your laſt Diviſor by it ; do ſo until yo
find nothing remaining ; then this laſt Diviſor ſhall b
your greateſt common Meaſurer, which will divide both
Numerator and Denominator, and reduce them both
into their loweſt Terms at one Work.

Example.

4. Reduce $\frac{228}{304}$ into its loweſt Terms by a commo Meaſurer ; to effect which, I divide the Denominato 304 by the Numerator 228, and there remains 76, then I divide 228 (the firſt Diviſor) by 76 (the Remainder and it quotes 3, and nothing remains ; wherefore th laſt Diviſor 76 is the common Meaſurer ; by which I divide the Numerator of the given Fraction, *viz.* 228, i quotes 3 for a new Numerator, then I divide the Denominator 304 by 76, and it quotes 4 for a new Denominator, ſo that now I have found $\frac{3}{4}$ equal to $\frac{228}{304}$.

5. Reduce $\frac{6048}{7892}$ into its loweſt Terms by a commo Meaſurer, *Facit* $\frac{9}{12}$.

6. Reduce $\frac{3084}{20582}$ into its loweſt Terms by a commo Meaſurer, *Facit* $\frac{11}{85}$.

A Compendium.

Note, That if the Numerator and Denominator of Fraction, and each with a Cypher or Cyphers, then cu off as many Cyphers from the one as from the othe and the remaining Figures will be a Fraction of the ſam Value, *viz.* $\frac{3400}{7100}$ will be found to be reduced to $\frac{3}{7}$ by cutting off the two Cyphers from the Numerato and Denominator with a Daſh of the Pen thus, $\frac{34|0}{71|0}$ and $\frac{460}{700}$, will be $\frac{46}{70}$, thus, $\frac{46|0}{70|0}$, &c.

V. *To find the Value of a Fraction in the known Parts Coin, Weights, &c.*

The Rule is,

Multiply the Numerator by the Parts of the ne inferior Denomination that are equal to an Unit the ſame Denomination with the Fraction ; then divide that Product by the Denominator, and the Quo gives you its Value in the ſame parts you multiply by, and if any thing remain, multiply it by the par of the next inferior Denomination, and divide as b fore ; do ſo till you can bring it no lower, and the ſeveral Quotients will give you the Value of the Fraction as was required ; and if any thing at laſt remain, place it for a Numerator over the former Denominator. Some new Examples will make the Rule plain.

1. What is the value of $\frac{27}{29}$ *l. Sterling* ? To anſwer this Queſtion, I multiply the Numerator 27 by 20, (the Shillings in a Pound) the Product is 540, which I divide by 29 (the Denominator) and the quotient is 18 *s.* and there remains 18, which I multiply by 12 Pence, and the Product (216) I divide by the Denominator 29, the quotient is 7 *d.* and 13 remains, which I multiply by 4 Farthings, the Product is 52, which I ſtill divide by 29, the Quotient is 1 qr. and there remaineth 23, which I put for a Numerator over the Denominator 29, ſo I find the Value of $\frac{27}{29}$ *l.* to be 18 *s.* 7*d.* 1 *qr.* $\frac{23}{29}$, as by the Work in the Margent ; and after the ſame Manner are the Values of the Fractions in the ſeveral Examples following found out.

$\frac{27}{29}$ *l.*
27
Multiply 20
qr.
29) 540 18s. 7d. 1 $\frac{23}{29}$
29
250
232
Remains (18)
Multiply 12
36
18
29) 216 (7 d.
203
Remains (13)
Multiply 4
qr.
29) 52 (1 $\frac{23}{29}$
29
Remains (23)
s. d. qr.
Facit, 18—7—1 $\frac{23}{29}$

And ſo likewiſe you may find the Value of any Fraction, either in Weight or Time, *&c.*

VI. *To reduce a compound Fraction to a ſimple One of the ſame Value.*

What a Compound Fraction is, hath been ſhewn in Chap. 1. Definition 24. and to reduce it to a Simple Fraction of the ſame Value,

The Rule is,

Multiply the Numerators continually, and place the laſt Product for a new Numerator, then multiply the Denominator continually, and place the laſt Product for a new Denominator. So this ſingle Fraction ſhall be equal to the compound Fraction. *Example.*

1. Reduce $\frac{2}{3}$ of $\frac{3}{5}$ of $\frac{5}{8}$ to a ſimple Fraction.

Multiply the Numerators 2, 3, and 5 together, they make 30 for a new Numerator; then I multiply the Denominators 3, 5 and 8 together, and their Product is 120 for a Denominator, ſo the ſimple Fraction is $\frac{30}{120}$, and cutting off the Cyphers, it is $\frac{3}{12}$, equal to $\frac{1}{4}$ by the fourth Rule following.

$$\begin{array}{r}5\\3\\\hline 15\\8\\\hline 120\end{array}\qquad\qquad\begin{array}{r}3\\2\\\hline 6\\5\\\hline 30\end{array}$$

Facit, $\frac{30}{120}$ or $\frac{3}{12}$ or $\frac{1}{8}$.

2. What is $\frac{7}{10}$ of $\frac{5}{9}$ of $\frac{4}{7}$ of $\frac{11}{12}$? *Anſwer*, $\frac{1540}{7560}$ or $\frac{154}{756}$, or $\frac{77}{378}$ in its Terms.

3. What is $\frac{11}{12}$ of $\frac{13}{14}$ of $\frac{21}{29}$? *Anſwer*, $\frac{3003}{4872}$.

By this you may know how to find the value of a Compound Fraction, *viz.* Firſt reduce it to a Simple one, and then find out his value by the 5th Rule foregoing.

Example.

4. What is the value of $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{9}{10}$ of a *Pound*? *Anſwer*, 11*s.* 3*d.*

VII.

VII. *To reduce Fractions of unequal Denominators to Fractions of the ſame Value, having equal Denominators.*

The Rule is,

Multiply all the Denominators together, and the Product ſhall be the common Denominator. Then muliply each Numerator into all the Denominators, except ts own, and the laſt Product put for a Numerator over he Denominator, found out as before: So this new raction is equal to that Fraction, whoſe Numerator you ultiply'd into the ſaid Denominators. Do ſo by all he Numerators given, and you have your deſire.

Example.

1. Reduce $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$ and $\frac{7}{8}$ to a common Denominator. ultiply the Denominators 4, 5, 6, and 8 together ontinually, and put the Products 960 for the common enominator; then multiply the Numerator 3 into the enominators 5, 6, and 8, and the product is 720, hich is a Numerator to 960 (found as before) ſo $\frac{720}{960}$ equal to the firſt Fraction $\frac{3}{4}$; then I proceed to find new Numerator to the ſecond Fraction; *viz.* $\frac{4}{5}$, and I ultiply 4 (into all the Denominators except its own, iz.) into 4, 6 and 8, which produceth $\frac{768}{960}$ equal to $\frac{4}{5}$, en multiply the Numerator 5 into the Denominators 5, and 8, the product is $\frac{800}{960}$ equal to $\frac{5}{4}$. Then multiply the Numerator 7 into the Denominators 4, 5, and , the product is $\frac{840}{960}$ equal to $\frac{7}{8}$, and the Work is one; ſo that for $\frac{3}{4}\frac{4}{5}\frac{5}{6}$ and $\frac{7}{8}$ I have $\frac{720}{960}$ $\frac{668}{960}$ $\frac{800}{960}$ and $\frac{40}{60}$.

2. Reduce $\frac{1}{1}\frac{1}{2}$, $\frac{1}{2}\frac{4}{5}$, and $\frac{1}{2}\frac{2}{1}$ in a common Denomina-, *faciunt* $\frac{3}{5}\frac{3}{7}\frac{1}{2}\frac{1}{6}$, $\frac{3}{6}\frac{5}{7}\frac{2}{8}\frac{5}{6}$ and $\frac{5}{5}\frac{3}{1}\frac{4}{9}\frac{4}{5}$.

VIII. *To reduce a Fraction of one Denomination to another.*

1. This is either Aſcending or Deſcending. Aſcend-g, when a Fraction of a ſmaller is brought to a great- Denomination; Deſcending, when a Fraction of a eater Denomination is brought lower.

3. When a Fraction is to be brought from a leſſer to greater Denomination, then make of it a Compound

Fraction, by comparing it with the intermediate De-nominations between it and that you would have i reduced to, then (by the 6th Rule foregoing) reduc your Compound to a Single Fraction, and the Work i done. *Example.*

Queſt. 1. It is required to know what part of a Poun *Sterling* $\frac{5}{7}$ of a Penny is?

To reſolve this, I conſider that 1 *d.* is $\frac{1}{12}$ of a Shil-ling, and a Shilling is $\frac{1}{20}$ of a Pound; wherefore $\frac{5}{7}$ is $\frac{5}{7}$ of $\frac{1}{12}$ of $\frac{1}{20}$ of a Pound, which by the ſaid 6th R I find to be $\frac{5}{1680}$ of a Pound *Sterl.* of *Engliſh* Money.

Queſt. 2. What part of a Pound *Troy-weight* is $\frac{4}{5}$ of *Penny weight*? *Anſ.* $\frac{4}{5}$ of $\frac{1}{20}$ of $\frac{1}{12}$ *l.* equal to $\frac{4}{1200}$ *l. Troy*

3. When a Fraction is to be brought from a greater to a leſſer Denomination, then multiply the Numera-tor by the parts contain'd in the ſeveral Denomination betwixt it, and the parts you would reduce it to; then place the laſt Product over the Denominator of the gi-ven Fraction. *Example.*

Queſt. 3. I would reduce $\frac{3}{5}$ *l.* to the Fraction of 1 *d.* to do which, I multiply the Numerator 3 by 20 and 12, the product is 720, which I put over the Denomi-nator 5, it makes $\frac{720}{5}$ of 1 *d.* equal to $\frac{3}{5}$ *l.*

Queſt. 4. What part of an Ounce *Troy* is $\frac{60}{18}$? *Anſwer* $\frac{16}{18}$ *oz.*

CHAP. XX.

Addition of Vulgar Fractions.

1. IF your Fractions to be added have a common De-nominator, then add all the Numerators together, and place their Sum for a Numerator to the common Denominator, which new Fraction is the Sum of all the given Fractions; and if it be improper, reduce it to a whole or mixt Number, by the 3d Rule of the 29th Chapter.

Queſt. 1. What is the Sum of $\frac{7}{24}$, $\frac{9}{24}$, $\frac{16}{24}$, and $\frac{14}{24}$?

The Denominators are equal, *viz.* every one is 24, wherefore add the Numerators together, *viz.* 7, 9, 16, and 14, their Sum is 46, which put over the Denominator 24, it makes $\frac{46}{24}$ the Sum of the given Fractions, which will be reduced to the mixt Numbers $1\frac{22}{24}$, or $1\frac{11}{12}$.

2. But if the Fractions to be added have unequal Denominators, then reduce them to a common Denominator by the 7th Rule of the 19th Chap. and then add the Numerators together, and put the Sum over the common Denominator, *&c.* as before in the laſt Example.

Queſt. 2. What is the Sum of $\frac{3}{5}$, $\frac{7}{8}$. $\frac{9}{10}$, and $\frac{11}{12}$?

The Fractions reduced to a common Denominator are $\frac{2880}{4800}$, $\frac{4200}{4800}$, $\frac{4320}{4800}$, and $\frac{4400}{4800}$, the Sum of their Numerators is 15800, which put over the common Denominator, makes $\frac{15800}{4800}$, or $\frac{158}{48}$ equal to the mixt Number $3\frac{14}{48}$, or $3\frac{7}{24}$ for the Sum required.

Queſt. 3. What is the Sum of $\frac{13}{17}$, $\frac{21}{49}$, and $\frac{39}{47}$? *Anſwer*, $1\frac{7555}{39151}$.

3. If you are to add mixt Numbers together, then add the Fractional parts as before, and if their Sum be an improper Fraction, reduce it to a mixt Number, and add its integral part to the integral parts of the given mixt Numbers, and the Work is done.

Queſt. 4. What is the Sum of $13\frac{3}{4}$ and $24\frac{5}{8}$?

Firſt add the Fractions $\frac{3}{4}$ and $\frac{5}{8}$, the Sum is $1\frac{12}{32}$, then add this Integer 1 to 13 and 24, their Sum is 38, and put after it the Fraction $\frac{12}{32}$ it is $38\frac{12}{32}$ for the Anſwer; or it is $38\frac{3}{8}$.

Queſt. 5. What is the Sum of $48\frac{3}{7}$, $64\frac{5}{8}$ and $130\frac{3}{4}$? *Facit* $243\frac{180}{224}$, or $243\frac{45}{56}$.

4. If any of the Fractions to be added, is a Compound Fraction, it muſt firſt be reduced to a Simple Fraction by the 6th Rule of Chapter 19, and then add it to the reſt, according to the 2d Rule of this Chapter. *Example.*

Q. 6. What is the Sum $\frac{1}{4}$ $\frac{5}{5}$ and $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{5}{6}$?

Ruce $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{5}{6}$ into a Simple Fraction, and it is $\frac{105}{195}$, which reduced with the other two, and added, are $1\frac{4686}{5760}$.

Q. 7. What is the Sum of $\frac{11}{12}$ and $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{5}{6}$? *Anſwer*, $1\frac{5}{12}$

5. If the Fractions to be added are not of one Denomination, they muſt be ſo reduced, and then proceed as before.

Qu. 8. What is the Sum of $\frac{3}{4}$ *l.* and $\frac{5}{6}$ *s.* ?

Of the given Fractions here, one is of a Pound, and the other the Fraction of a Shilling; and before you can add them together, you muſt reduce $\frac{5}{6}$ *s.* to the Fraction of a pound as the other is (by the 8th Rule of Chap. 19.) and it makes $\frac{5}{120}$ *l.* then $\frac{3}{4}$ and $\frac{5}{120}$ *l.* will be found to be kkk *l.* or kk *l.* by the 7th Rule of Chapter 19, and in its loweſt Terms $\frac{19}{24}$ *l.* by the 4th Rule of Chapter 19.

It would have been the ſame if (by the latter part of the 8th Rule of Chapter 19) you had reduced $\frac{3}{4}$ *l.* to the Fraction of a Shilling; which you would have found to have been $\frac{60}{4}$ *s.* which added to $\frac{5}{6}$ *s.* by the ſaid 17th Rule of the laſt Chapter, the Sum is 15*l.* $\frac{20}{24}$ which is equal to the Sum found, as before, *viz.* $\frac{19}{24}$ *l.* for (by the 5th Rule of Chapter 19) the value of $\frac{16}{24}$ *l.* will be found to be 15*s.* 10*d.* and ſo will 15*s.* $\frac{20}{24}$ be found to be juſt as much.

Queſt. 9. What is the Sum of $\frac{2}{5}$ *l.* $\frac{3}{5}$ *s.* and $\frac{3}{5}$ *d.* ?
Anſ. $\frac{379500}{900000}$ or $\frac{3795}{9000}$ *l.* or in its loweſt Terms $\frac{253}{600}$.

C H A P. XXI.

Subtraction of Vulgar Fractions.

1. THE Rules in *Addition* for reducing the given Fractions to one Denomination, are here to be obſerved; for before Subtraction can be made, the Fractions muſt be reduced to a common Denominator, then ſubtract one Numerator from the other, and place the Remainder over a Common Denominator, which Fraction ſhall be the Exceſs or Difference between the given Fraction. *Examples.*

Q. 1. What is the difference between $\frac{3}{4}$ and $\frac{5}{7}$? The given Fractions are reduced to $\frac{21}{28}$ and $\frac{20}{28}$, then ſubtract the Numerator 20 from the Numerator 21, and there remains 1, which being put over the Denominator 28, makes $\frac{1}{28}$ for the Anſwer or Difference between $\frac{3}{4}$ & $\frac{5}{7}$

Q. 2. What is the difference between $\frac{5}{6}$ and $\frac{8}{9}$ of $\frac{1}{4}$? Reduce the Compound Fraction $\frac{1}{4}$ of $\frac{8}{9}$ to a Simple Fraction, then proceed as before, and the Anſwer is $\frac{210}{540}$ equal to $\frac{11}{34}$.

2. When a Fraction is given to be ſubtracted from a Whole Number, ſubtract the Numerator from the Denominator, and put the Remainder for a Numerator to the given Denominator, and ſubtract an Unit (for that you borrow'd) from the Whole Number, and the Remainder place before the Fraction found, as before, which mix'd Number is the Remainder or Difference ſought. Example.

Q. 3. Subtract $\frac{7}{10}$ from 48.

Anſwer 47 $\frac{3}{10}$; for if you ſubtract 7 (the Numerator) from 10 (the Denominator) there remains 3, which put over 10 is $\frac{3}{10}$ and 1 (I borrow'd) from 48 and 47; to which joyn $\frac{3}{10}$, and it makes 47 $\frac{3}{10}$ for the Exceſs.

Q. 4. Subtract $\frac{13}{21}$ from 57, remains 56 $\frac{8}{21}$.

3. If it be required to ſubtract a Fraction from a mixt Number, or one mixt Number from another, reduce the Fraction to a common Denominator, and if the Fraction to be ſubtracted be leſſer than the other, then ſubtract the leſſer Numerator from the greater, and that is a Numerator for the common Denominator, then ſubtract the leſſer integral part from the greater, and the Remainder with the remaining Fraction thereto annexed, is the Difference required between the two given mixt Numbers. *Example.*

Queſt. 5. Subtract 26 $\frac{3}{7}$ from 54 $\frac{5}{6}$.

Firſt, Subtract $\frac{3}{7}$, *viz.* $\frac{18}{42}$ from $\frac{5}{6}$, *viz.* $\frac{35}{42}$, the Remainder is $\frac{17}{42}$, then 26 from 54, remaineth 28, to which annex $\frac{17}{42}$ it makes 28 $\frac{17}{42}$ for the Anſwer.

4. But if the Fraction to be ſubtracted is greater than the Fraction from whence you ſubtract, then having firſt reduced the Fractions to a common Denominator, take the Numerator of the greateſt Fraction out of the Denominator, and add the Remainder to the Numerator of the leſſer Fraction, and their Sum is a new Numerator to the common Denominator, which Fraction note, then (for the 1 you borrow'd) add 1 to the integral part to be ſubtracted, and ſubtract it from the

greater Number, and to the Remainder annex the Fraction you noted before, ſo this new mixt Number ſhall be the Difference ſought. *Example.*

Queſt. 6. Subtract $14\frac{3}{4}$ from $29\frac{4}{7}$.

The Fractions reduc'd are, *viz.* $\frac{3}{4}$ equal to $\frac{21}{28}$, and $\frac{4}{7}$ equal to $\frac{16}{28}$, now I ſhould ſubtract $\frac{21}{28}$ from $\frac{16}{28}$, but I cannot, therefore I ſubtract 21 and 28, reſts 7, which added to 16 (the leſſor Numerator) makes 23 for a Numerator to 28, *viz.* $\frac{23}{28}$; then I come to the integral parts 14 and 29, and ſay, 1 that I borrow'd and 14 is 15, which taken from 29, there reſts 14, to which annexing $\frac{23}{28}$ it is $14\frac{23}{28}$ for the Remainder or Difference between $14\frac{3}{4}$ and $29\frac{4}{7}$.

Q. 7. Subtract $36\frac{9}{10}$ from $74\frac{4}{9}$, *facit* $37\frac{49}{90}$.

CHAP. XXII.

Multiplication of Vulgar Fractions.

1. IF the Multiplicand and Multiplier are Simple Fractions, then multiply the Numerators together for a new Numerator, and the Denominators for a new Denominator and the new Fraction is the Product required.

Queſt. 1. What is the Product of $\frac{5}{7}$ by $\frac{9}{11}$? *Facit*, $\frac{45}{77}$, for the Numerators 5 and 9 being multiply'd, make 45, and the Denominators 7 and 11 being multiply'd make 77.

Queſt. 2. What is the Product of $\frac{18}{23}$ by $\frac{21}{37}$? *Facit*, $\frac{378}{851}$.

2. If the Fractions to be multiply'd be mixt Numbers, reduce them to Improper Fractions by the firſt Rule of the 19th Chapter; then proceed as before.

Queſt. 3. What is the Product of $28\frac{3}{5}$ by $13\frac{5}{6}$?

The given mixt Numbers being reduc'd to Improper Fractions are $48\frac{3}{5}$ equal to $\frac{243}{5}$, and $13\frac{5}{6}$ equal to $\frac{83}{6}$, now $\frac{243}{5}$ multiplied by $\frac{83}{6}$, according to the firſt Rule of this Chapter, produceth $\frac{20169}{30}$, or $672\frac{9}{30}$.

Queſt. 4. What is the Product of $430\frac{6}{10}$ by $18\frac{3}{7}$? *Facit*, $\frac{555474}{70}$ or $7935\frac{24}{70}$.

3. If a Compound Fraction is to be multiplied by a Simple Fraction, firſt reduce the Compound Fraction into a Simple Fraction, then multiply the one by the other, as is taught above.

Queſt. 5. What is the Product of $\frac{16}{21}$ by $\frac{3}{4}$ of $\frac{5}{7}$ of $\frac{4}{5}$? The Compound Fraction $\frac{3}{4}$ of $\frac{5}{7}$ of $\frac{4}{5}$ reduced is $\frac{60}{140}$, or $\frac{6}{14}$ which multiply by $\frac{16}{21}$ produceth $\frac{96}{294}$, which in its loweſt Term is $\frac{16}{49}$ for the Anſwer.

And if the Multiplicand and Multiplier are both Compound Fractions, reduce them both to Simple ones, then multiply theſe new Fractions as before, ſo you have the product.

Queſt. 6. What is the Product of $\frac{3}{4}$ of $\frac{2}{3}$ of $\frac{3}{5}$ of $\frac{1}{2}$? *Anſwer*, $\frac{18}{120}$ in its loweſt Terms $\frac{3}{20}$.

Q. 7. What is the Product of $\frac{2}{5}$ of $\frac{3}{4}$ by $\frac{3}{5}$ of $\frac{5}{8}$? *Anſwer*, $\frac{60}{360}$, or $\frac{6}{36}$, or in it leaſt Terms $\frac{1}{6}$.

4. If a Fraction be to be multiplied by a Whole Number, put under the given Whole Number an Unit for a Denominator, whereby it will be an improper Fraction, then multiply theſe Fractions as before. *Example.*

Queſt. 8. What is the Product of 24 by $\frac{2}{3}$? *Anſwer*, $\frac{48}{3}$, for 24 by putting an Unit under it will be $\frac{24}{1}$ and $\frac{24}{1}$ by $\frac{2}{3}$ produceth $\frac{48}{3}$ or 16.

Queſt. 3. What is the Product of 36 by $\frac{9}{11}$? *Anſwer* $\frac{324}{11}$ or $29\frac{5}{11}$.

CHAP. XXIII.

Diviſion of Vulgar Fractions.

1. IF the Dividend and the Diviſor are both Simple Fractions, then multiply the Numerater of the Dividend into the Denominator of the Diviſor, and the Product is a new Numerator, and multiply the Denominator of the Dividend into the Numerator of the Diviſor, and the Product is a new Denominator, which new Fraction thus found, is the Quotient you deſire. *Example.*

Queſt. 1. What is the Quotient of $\frac{5}{8}$ divided by $\frac{3}{5}$? *Anſ.* $\frac{25}{24}$, or $1\frac{1}{24}$, for firſt I multiply (5) the Numerator of the Dividend into (5) the Denominator of the Diviſor, and the Product (25) is a Numerator for the Quotient, then I

$$\frac{3}{5}\Bigg)\frac{5}{8}\Bigg(\frac{25}{24}$$

multiply (8) the Denominator of the Dividend, into (3) the Numerator of the Diviſor, and the product (24) I put in the Quotient for a Denominator, ſo I find $\frac{15}{24}$ is the Quotient ſought.

Queſt. 2. What is the Quotient of $\frac{10}{21}$ divided by $\frac{2}{3}$?

Anſwer, $\frac{30}{42}$ equal to $\frac{5}{7}$ in its loweſt terms.

2. But if you would divide a Simple Fraction by a Compound, or a Compound by a Simple, firſt reduce ſuch Compound to a Simple Fraction, then go on as before.

Q. 3. What is the Quotient of $\frac{3}{10}$ divided by $\frac{3}{4}$ of $\frac{2}{3}$?

Anſwer, $\frac{36}{60}$ or $\frac{6}{3}$, firſt reduce $\frac{3}{4}$ of $\frac{2}{3}$ into a Simple Fraction, and it is $\frac{6}{12}$, by which $\frac{3}{10}$ being divided, the Quotient is $\frac{36}{60}$ equal in its leaſt Terms to $\frac{6}{3}$, and if the Dividend and Diviſor be both Compound Fractions, reduce them both to a ſimple Fraction, then divide the one by the other, as in Rule 1. foregoing.

Q. 4. What is the Quote of $\frac{2}{8}$ of $\frac{3}{4}$ divided by $\frac{1}{2}$ of $\frac{5}{6}$?

Anſwer, $\frac{180}{120}$ or $\frac{18}{12}$ or 1 $\frac{6}{12}$ or $1\frac{1}{2}$ in its loweſt Terms.

3. If the Dividend, or Diviſor, or both are mix'd Numbers, reduce them to Improper Fractions, and perform Diviſion as you were taught before.

Q. 5. What is the Quote of $12\frac{3}{4}$ divided by $21\frac{4}{5}$?

Anſwer, $\frac{255}{436}$, for $12\frac{3}{4}$ is equal to $\frac{51}{4}$, and $21\frac{4}{5}$ is equal to $\frac{109}{5}$, and the Quote of $\frac{51}{4}$ divided by $\frac{109}{5}$ is as before, $\frac{255}{428}$.

4 If you divide a Fraction by a whole Number, or a Whole Number by a Fraction, make the whole Number an Improper Fraction, by putting an Unit for a Denominator to it as was taught in Rule 4. of Chapter 22, and then perform Diviſion as was before taught.

Example.

Q. 6. What is the Quote of 8 divided by $\frac{3}{5}$?

Anſwer, $\frac{40}{3}$ which is equal to $13\frac{1}{3}$, being reduced as is before directed. See the Work in the Margent.

$$\frac{3}{5}\Big)\frac{8}{1}\Big(\frac{40}{3} \text{ or } 13\tfrac{1}{3}$$

Q. 7. What is the Quotient of $\frac{3}{5}$ divided by 8?

Anſwer, $\frac{3}{40}$, as *per* Margent.

$$\frac{8}{1}\Big)\frac{3}{5}\Big(\frac{3}{40}$$

CHAP.

CHAP. XXIV.

he Rule of Three Direct in Vulgar Fractions.

. AS in the Rule of Three in Whole Numbers, ſo likewiſe in Fractions, you muſt ſee that the ractions of the firſt and third Places be of the ſame enomination.

2. If any of the given Fractions be Compound, let hem be reduc'd to Simple of the ſame Value.

3. If there are given mixed Numbers, reduce them o improper Fractions by the firſt Rule of Chap. XIX.

4. If any of the three Terms is a Whole Number ake it an improper Fraction by conſtituting an Unit or its Denominator.

Having reduc'd your Fraction as is directed in the our laſt Rules, then proceed to a Reſolution, which is perform'd the ſame way as in Whole Numbers, reſpect being had to the Ruſes deliver'd for the working of Fractions, *viz.* Multiply the 2d and 3d Fractions together according to the 1ſt Rule of Ch. XXII. and divide the product by the 1ſt Fraction, according to the firſt Rule of Ch. XXIII. and the Quotient is the Anſwer.

Or, (which is better)

5. Multiply the Numerator of the firſt Fraction into the Denominator of the ſecond and third, and the Product is a new Denominator, then multiply the Denominator of the firſt Fraction into the Numerator of the ſecond and third, and the product is a new Numerator, which new Fraction is the 4th Proportional or Anſwer, which (if it be an Improper Fraction) muſt be reduc'd to a whole or mix'd Number by the 3d Rule of Chap. XIX. *Examples.*

Queſt. 1. If $\frac{3}{4}$ Yards of Cloth coſt $\frac{5}{8}$ *l.* what will $\frac{6}{10}$ Yards coſt?

Having placed the given Fractions according to the 6th Rule of Chap. X. I proceed to the Reſolution, and firſt I multiply the Numerator of the 1ſt Fraction (3) into 8 and 10, the Denominators of the ſecond and third Fractions, and the Product is 240 for a Denominator; then I multiply 4 the Denominator of the firſt Fraction into 5 and 9, the Numerators of the ſecond and third Fractions, the Product is 180 for a Numerator, which Numerator 180 and Denominator 240 make $\frac{180}{240}$ *l* for the *Anſwer*, equal to $\frac{3}{4}$ or 15 *s*.

yards	l.	yards	l.
$\frac{3}{4}$	$\frac{5}{8}$	$\frac{9}{10}$	$\frac{180}{240}$

l.
Facit, $\frac{180}{240}$ equal to $\frac{3}{4}$

Queſt. 2. If $\frac{2}{3}$ *l*. buy $\frac{5}{6}$ yards of Cloth, what will $\frac{11}{12}$ yards coſt at that rate?

Anſwer, kkk *l*. equal to $\frac{11}{15}$ *l*. or 14 *s*. 8 *d*.

Qu. 3. If $\frac{7}{8}$ *l*. coſt $\frac{3}{4}$ *s*. what will $\frac{8}{9}$ *s*. buy?

Anſwer, $\frac{168}{162}$ *l* equal to $1\frac{1}{27}$ *l*.

Qu. 4. If $\frac{3}{5}$ of an Ell of Holland coſt h of a Pound, how much will 12 h Ells coſt at that Rate?

Anſwer, $\frac{200}{27}$ equal to $7\frac{11}{27}$ *l*.

In reſolving the laſt Queſtion and the two next, obſerve the 3d Rule of the Chapter foregoing.

Qu. 3. If $\frac{8}{9}$ of a C. coſt 284 *s*. what will $7\frac{1}{2}$ C. coſt at that Rate?

Anſwer, $239\frac{7}{12}$ *s*. or 11 *l*. 19 *s*. 7 *d*.

Qu. 6. If $3\frac{1}{4}$ Yards of Velvet coſt $3\frac{5}{8}$ *l*. how much will $10\frac{1}{2}$ Yards coſt at that Rate?

Anſwer, $11\frac{37}{52}$ *l*.

Qu. 7. If 5 Yards of Broad-cloth coſt $2\frac{4}{5}$ *l*. what will $14\frac{3}{7}$ Yards coſt?

Anſwer, 13 *l*. 9 *s*. 4 *d*.

In working the laſt Queſtion and the 4 next, obſerve the 4th Rule of the Chapter foregoing.

Qu. 8. If 14 *l*. of Pepper coſt 14 *s*. $6\frac{3}{5}$ *d*. I demand the price of $73\frac{3}{4}$ *l*.?

Anſwer, 3 *l*. 16 *s*. $7\frac{43}{56}$ *d*.

Qu. 9. If 1 *l*. of Cocheneel coſt 1 *l*. 5 *s*. what will $36\frac{7}{10}$ *l*. coſt?

Anſwer, 47 *l*. 17 *s*. 6 *d*.

Qu. 10. If 1 Yard of Broad-cloth coſt $15\frac{5}{7}$ *s.* what will 4 pieces, each containing $27\frac{3}{8}$ Yards coſt at that Rate? *Anſwer*, 85*l.* 14*s.* $3\frac{3}{7}$ *d.*

Qu. 11. A Mercer bought $3\frac{1}{2}$ pieces of Silk, each piece contain'd $24\frac{2}{3}$ Ells at 6*s.* $0\frac{3}{4}$ *d. per* Ell, I demand the value of $3\frac{1}{2}$ pieces at that Rate?

Anſwer, 26*l.* 3*s.* $4\frac{3}{4}$ *d.*

In reſolving the four next Queſtions obſerve the 8th Rule of Chapter 19.

Qu. 12. If $\frac{3}{5}$ of an Ounce of Silver coſt 2*s.* I demand the price of $11\frac{2}{8}$ *l.* at that Rate?

Anſwer, 35*l.*

Qu. 13. If $1\frac{5}{7}$ *l.* of Gold is worth $61\frac{4}{7}$ *l. Sterling*, what is a Grain worth at that Rate?

Anſwer, $1\frac{1}{7}$ *d.*

Qu. 14. If $\frac{3}{4}$ Yard of Silk is worth $\frac{3}{4}$ of $\frac{5}{6}$ *l.* what is the price of $15\frac{2}{9}$ Ells Flemiſh?

Anſwer, 9*l.* 12*s.* 6*d.*

Qu. 15. If $\frac{2}{3}$ of $\frac{3}{4}$ of a pound of Cloves coſt 6*s.* $2\frac{2}{7}$ *d.* what coſt the *C.* Weight at that Rate?

Anſwer, 69*l.* 6*s.* 8*d.*

Note, That when the Anſwers to the Queſtion in this and the next Chapter are given in Fractions, they are given in their loweſt Terms.

CHAP. XXV.

The Rule of Three Inverſe in Fractions.

1. IT hath been already taught (in the third Rule of the 11th Chapter) how to diſcover when the 4th proportional Number (to the three given Numbers) is to be found out by a *Rule of Three Direct*, and when by a *Rule of Three Inverſe*; to which Rule the Learner is now referred.

2. When (in Fractions) you find a Queſtion to be ſolved by the *Rule of Three Inverſe*, *viz.* when the third Term is the Diviſor, than having reduced the Terms

exactly (according to the Rules in Chap. 34) multiply the Numerators of the 3 Fractions into the Denominators of the 2d and 1ſt Fractions, and the product is a new Denominator; then multiply the Denominator of the third Fraction into the Numerators of the 2d and 1ſt Fractions, and the product is a new Numerator, which new Fraction thus found, is the Anſwer to the Queſtion.

Queſt. 1. If $\frac{3}{4}$ of a yard of Cloth that is 2 yards wide will make a Garment, how much of any other Drapery that is $\frac{3}{5}$ of a yard wide will make the ſame Garment?

Anſwer, $2\frac{1}{2}$ yards.

Queſt. 2. I lent my Friend 46*l.* for $\frac{4}{5}$ of a year, how much ought he to lend me for $\frac{7}{12}$ parts of a year?

Anſwer, $63\frac{3}{5}$ *l.*

Queſt. 3. If $\frac{2}{3}$ of a yard of Cloth that is $2\frac{1}{3}$ yards wide will make any Garment, what breadth is that Cloth when $1\frac{1}{4}$ yard will make the ſame Garment?

Anſwer, $\frac{56}{45}$ of a yard wide.

Queſt. 4. How many Inches in length of a Board that is 9 Inches broad will make a Foot ſquare?

Anſwer, 16 Inches in length.

Queſt. 5. If when the Buſhel of Wheat coſt $4\frac{3}{4}$ *s.* the Penny-Loaf weighed $10\frac{2}{3}$ Ounces, what will it weigh when the Buſhel coſt $8\frac{9}{10}$ *s.*?

Anſwer, $5\frac{185}{267}$ Ounces.

Queſt. 6. If 12 Men can can mow $24\frac{1}{2}$ Acres in $10\frac{2}{3}$ Days, in how many days will 6 Men do the ſame?

Anſwer, In $21\frac{1}{3}$ Days.

CHAP. XXVI.

Rules of Practice.

IN the *Single Rule of Three*, when the firſt of the three Numbers in the Queſtions (after they are diſpoſed according to the 6th Rule of Chapter 10) happeneth to be an Unit (or 1) that Queſtion many times may be reſolved far more ſpeedily than by the *Rule of Three*, which kind of Operation is commonly called *Practiſe*, nd indeed it is of excellent Uſe among Merchants, Tradeſmen, and others, by reaſon of its Speedineſs in inding a Reſolution to ſuch kind of Queſtions.

2. The chiefeſt Queſtions reſolvable by theſe brief Rules, may be comprehended under the three general Heads or Caſes following, *viz.*

When the iven Price f the Integer conſiſts,
1 *Of Farthings under* 4.
2 *Of Pence under* 12.
3 *Of Pence and Farthings.*
4 *Of Shillings under* 20.
5 *Of Shillings, Pence and Farthings.*
6 *Of Pounds.*
7 *Of Pounds, Shillings, Pence and Farthings.*

It would be very convenient for the practical Arithmetician to have by Heart the ſeveral Products of the 9 Digits multiply'd by 12, for his ſpeedy reducing Pence into Shillings, and Shillings into Pence, which he may gain by the following Table.

12 Times	1	is	12
	2		24
	3		36
	4		48
	5		60
	6		72
	7		84
	8		96
	9		108

3. Shillings are practically reduced into Pounds thus, *viz.* Cut off the Figure ſtanding in the Place of Units with a daſh of the Pen, and note it for Shillings, then draw a Line under the given Number, and take half of the remaining Figures (after the firſt is cut off) and ſet them under the Line, and they are ſo many Pounds; but if the laſt Figure is odd, then take the leſſer half, and add 10 to the Figure ſo cut off (as before) for Shillings, as if I were to reduce 43658 Shillings into Pounds, firſt

4365	8
l.	s.
2182	18

I cut off the laſt Figure (8) for Shillings, then I take half of the remaining Figures (4365) thus, half of 4 is 2, which I put under the Line, then half of 3 is 1, and becauſe 3 is an odd Number, I make the next Figure 6 to be 16, and I go on, ſaying, half of 16 is 8, and then half of 5 is 2, which is the laſt Figure; wherefore becauſe 5 is an odd Number, I add 10 to the 8 I cut off, and it makes 18 *s.* ſo that I find it to be 2182*l.* 18*s.* as *per* Margent.

4. It is likewiſe convenient that the Learner be acquainted with the Practical Tables following, the firſt containing the Aliquot or even parts of a Shilling, the ſecond containg the Aliquot parts of a Pound.

The even parts of a ſhilling.

d.		*s.*
6	is	$\frac{1}{2}$
4		$\frac{1}{3}$
3		$\frac{1}{4}$
2		$\frac{1}{6}$
1$\frac{1}{2}$		$\frac{1}{8}$
1		$\frac{1}{12}$

The even parts of a pound.

s.	*d.*		*l.*
10	00	is	$\frac{1}{2}$
6	08		$\frac{1}{3}$
5	00		$\frac{1}{4}$
4	00		$\frac{1}{5}$
3	04		$\frac{1}{6}$
2	06		$\frac{1}{8}$
2	00		$\frac{1}{10}$
1	08		$\frac{1}{12}$
1	00		$\frac{1}{20}$

Caſe 1.

5. **When the price of an Integer is a Farthing, then take the 6th part of the given Number, which will be ſo many Three-half-pences, and if any thing remains it is Farthings by the 7th Rule of Chap. 9. then conſider that three half-pences is $\frac{1}{8}$ of a Shilling, wherefore take the eighth part of them for Shillings, and if any thing remain, they are ſo many Three-half-pences, which reduce into Pounds by the 3d Rule foregoing.** *Example*, What comes 67486 *l.* to, at a Farthing *per l.*? Firſt, I take $\frac{1}{6}$ of 67485, and it is 11247 Three-half-pences and 4 Farthings, or 1 Penny, then $\frac{1}{8}$ of 11247 is 1405 *s.* and 7 remains, which is 7 Three half pences, or 10$\frac{1}{2}$ *d.* which, with the 4 Farthings before, make 11$\frac{1}{2}$ *d.* and 1405*s.* which by the 3d Rule is 70*l.* 5*s.* In all 70*l.* 5*s.* 11$\frac{1}{2}$ *d.* for the Anſwer. See the Work following.

67485

$\frac{1}{8}$ | 67486 *at* $\frac{1}{4}$ *per l.*
———————*d.*
$\frac{1}{8}$ | 11247——1
$\frac{1}{20}$ | 140|5—10$\frac{1}{2}$
l. *s.* *d.*
70—5—11$\frac{1}{2}$ *facit.*

Other Examples follow.

$\frac{1}{8}$ | 8576 *l.* *at* 1 *qr.*
$\frac{1}{8}$ | 1429 —— 2 *qrs.*
$\frac{1}{20}$ | 17|8 ——8 *d.*
l. s. d.
8—18—8 *facit*

$\frac{1}{8}$ | 6380 *l.* *at* 1 *qr.*
$\frac{1}{8}$ | 1063 —— 2 *qrs.*
$\frac{1}{20}$ | 131|2 - 11 *d.*
l. s. d.
6—12—11 *facit*

6. When the Price of the Integer is 2 Farthings, then take the third part of the given Number for ſo many Three-half pence, and the Remainder (if any) is half-pence, then take the eighth part of that for Shillings, as before, *&c.*

Example.

$\frac{1}{3}$ | 7368 *l.* *at* 2 *qrs.*
$\frac{1}{8}$ | 2456
$\frac{1}{20}$ | 30|7
l. s.
15——7 *facit*

$\frac{1}{3}$ | 8347 *l.* *at* 2 *qrs.*
$\frac{1}{8}$ | 2782——2 *qrs.*
$\frac{1}{20}$ | 34|7——9*d.* $\frac{1}{2}$.
l. s. d.
17—7—9$\frac{1}{2}$ *facit*

7. When the price of the Integer is 3 Farthings, then take half the given Number for Three half-pence, and if any thing remain it is 3 Farthings; then take the eighth of that for Shillings, as before, *&c.*

$\frac{1}{2}$	4736 *l. at* 3 *qrs.*
$\frac{1}{8}$	2368
$\frac{1}{20}$	29|6
	l. s.
	14—16 *facit*

$\frac{1}{2}$	5425 l. *at* 3 *qrs.*
$\frac{1}{8}$	2712——3 *qrs.*
$\frac{1}{20}$	33|9
	l. s. d. qrs.
	16--19-0--3 *fa.*

Caſe 2.

8. When the given price of the Integer, is a part or parts of a Shilling, (*viz.* Pence) divide the given Number of Integers (whoſe Value is ſought) by the Denominator of the Fraction repreſenting the even part, and the Quote is Shillings (always minding the 7th Rule of the 9th Chapter) and thoſe Shillings may be reduced into Pounds by the 3d Rule of this Chapter. *Example :* Let it be required to find the Value of 438*l.* at 3*d. per l.* I conſider 3*d.* is $\frac{1}{4}$ of a Shilling, and 438*l.* will coſt ſo many 3 pences, wherefore I divide 438 by 4 the Denominator of $\frac{1}{4}$, and the Quote is 109 Shillings, and 2 remains, which is 2 Three-pences or 6*d.* the whole Value is 5*l.* 9*s.* 6*d.* as by the following Work appeareth,

$\frac{1}{4}$	438 l. at 3 d.
$\frac{1}{20}$	10|9——6
	l. s. d
Facit,	5—9—6

If the Learner is minded to try the Fruitfulneſs of his Genius, he may frame as many Examples as he thinks fit, and work 'em as before.

9. If the price of the Integer be Pence under 21, and yet not an even part, that it may be divided into even parts, and ſo the parts of the given Numbers taken accordingly, and added together, as if it were 5*d.* which is 3*d.* and 2*d. viz.* $\frac{1}{4}$ and $\frac{1}{6}$ of a Shilling, firſt take $\frac{1}{4}$ of the given Number, and then $\frac{1}{6}$ thereof, and add them together, and their Sum is the Anſwer in

Shillings, ſtill obſerving Rule 7. of Chapter 9. for the Remainder (if any be) then bring the Shillings into Pounds by the third Rule foregoing. Likewiſe 7 *d.* is ⅓ and ¼, ſo 9*d.* is ½ and ¼, and 10¼ *d.* is ¼ and ¼ is 11*d.* is ⅓ and ⅓ and ¼ of a Shilling, or elſe many times your Work may be ſhortened thus, *viz.* when the ſaid given price is to be divided into even parts of a Shilling, or of a Pound. After you have taken the firſt even part, the other may be an even part of that part, as in the next Example, where is given 439 *l.* at 5*d. per l.* now I may divide it thus, *viz.* into 4*d.* 1*d.* and 4*d.* being ⅓ of a Shilling, and 1*d.* being ¼ of 4*d.* I firſt take ⅓ of 439*l.* and it gives 146*s.* 4*l.* and for the 1*d.* I take ¼ of 146*s.* 4*d.* which is 36*s.* 7*d.* which in all comes to 9*l.* 2*s.* 11*d.* Examples follow.

	l. *d.*
	439 *at* 5 *per l.*
⅓	146 — 4
¼	36 — 7
	18|2 — 11
	9*l.* 2*s.* 11*d.* *facit*

	yds *d.*
	417 *at* 9 *per yd.*
½	208 — 6
½	104 — 3
	31|2 — 9
	15*l.* 12*s.* 9*d.* *facit*

	ells. *d.*
	587 *at* 7 *per ell*
⅓	195 — 8
¼	146 — 9
	34|2 — 5
	17*l.* 2*s.* 5*d.* *facit*

	ells *d.*
	186 *at* 10
½	193
¼	128 — 8
	32|1 — 8
	16*l.* 10*s.* 8*d.* *facit*

	yds	d.
	836 *at*	8 *per yd*
1/3	278——8	
	278——8	
	5517——4	
	27*l.* 17*s.* 4*d.* *facit*	

	l.	d.
	534 *at*	11
1/3	178	
k	178	
1/4	133——6	
	48|19——6	
	24*l.* 9*s.* 6*d.* *facit*	

Caſe 3.

10. When the price of the Integer is Pence and Farthings, if it make an even part of a Shilling, Work as before; but if they are uneven, as Penny Farthing, Penny three Farthings, 2 d. 1 qr. or 2 d. 3 qrs. 3d. 3qrs. or the like, then firſt work for ſome even part,and then conſider what part the reſt is of that even part, and divide that Quotient thereby, then add them together, and reduce them to Pounds as before. *Example.* 3470 l. at 1 d. 1 qr. per l. firſt I work for the Penny by dividing 3470 l. by 12, for 1 d. is 1/12 of a Shilling, and the Quote is 289 s. 2 d. then I conceive that one Farthing is the 1/4 of a Penny, and the value of 1 Farthing will be 1/4 of the value of a Penny, and therefore I take 1/4 of 289 s. 2d. which is 72s. 3d. 2 qrs. and add them together, and they are 18 l. 1 s. 5 d. 2 qrs. as by the Margent.

	l.		d.	qrs.
	3470 at		1	3
1/4	289		2	
	72		3	1/2
1/20	36|1		5	2
	l.	s.	d.	qrs.
	18	1	5	1/2

Caſe 4.

11. When the price of the Integer is 2 s. then cut off the Figure in the place of Units of the given Number, and double it for Shillings, and the Figures on the other hand are Pounds. *Example*, 436 yards at 2s *per* yard,cut off the laſt Figure 6,and double it,it makes 12 s. and the other two Figures, *viz.* 43 are ſo many Pounds; ſo that their Value is 43 l. 12 s. as *per* Margent.

43\|6

43l.12s.

12. Hence it is evident that when the given price of
n Integer is an even Number of Shillings, then if you
ake half of that (even) Number of Shillings, and mul-
iply the given Number of Integers thereby, doubling
he firſt Figure of the Product, and ſetting it apart for
hillings, the reſt of the Product will be Pounds, which
ounds and Shillings are the Value ſought. *Example*:
Vhat coſt 536 Yards at 8*s*. *per* yd ? To reſolve which,
take half of 8*s*. (the price of a yard) which is 4, and
ultiply 536 thereby, ſaying, 4 times 6
24, then I double the firſt Figure 4
akes 8 for Shillings, and carry 2 to
e next Product, &c. I find the reſt
f the Product to be 214, which I note
r Pounds; ſo the Value of 536 yards at 8*s*. *per* yard,
214*l*. 8*s*. as by the Margent. Other Examples of the
me kind may be framed and wrought after the like
anner.

536 yds. at 8*s*.
214*l*. 8*s*.

13. If the given price of the Integer is an odd Num-
r of Shillings, then work firſt for the even Number
Shillings by the laſt Rule, and for the odd Shilling
ke $\frac{1}{20}$ of the given Number of Integers, according to
e 3d Rule of this Chapter, and add them together,
d you have your Deſire. *Examples* follow.

s. s.
2 at 3 per yard
l. s.
2 — 4
1 — 2
3 — 6 facit

ells s.
431 at 13
l. s.
258 — 12
21 — 11
280 — 03 facit

s s.
6 at 7 per ell
s.
4 — 16
— 16
— 12 facit

ells s.
324 at 17 per ell
l. s.
259 — 04
16 — 04
275 — 08 facit

14. Except when the given price of the Integer is 5 *s.* for then it is ſooner anſwered by taking ¼ of the given Number, whoſe Value is ſought, as in the following Example.

	yds	s.		ells	s.
¼	436 at	5 per yd.	¼	206 at	5 per ell.
	109 l. *facit*			51 l. 10 s. *facit*	

Caſe 5.

15. When the given Price of an Integer is Shilling and Pence, or Shillings, Pence and Farthings; then i the Shillings and Pence be an even part of a Pound divide the given Number of Integers, whoſe value yo ſeek by the Denominator of that Fraction repreſentin that even part. As for *Example*, What is the price 384 Yards at 6*s.* 8*d.* *per* Yard? Here I conſider that 6 8*d.* is ⅓ of a Pound, wherefore divide 384 by 3, an the Quote is the Anſwer, *viz.* 128 *l.* ſo that 384 *yds.* at 6*s.* 8*d.* *per yard*, amounts to 128 *l.* as *per* Margent, ſtill obſerving the 7th Rule of the 9th Chapter.

⅓	384
	128 *l.* *fa*

16. When the given Value of the Integer is Shillin and Pence, and not an even part of a Pound, yet ma times it may be divided into parts (*viz.* 6*s.* 6*d.* is 4 and 2*s.* 6*d.* for the 4*s.*) Work according to the 12 Rule foregoing, and for the 2*s.* 6*d.* take the eighth p of the given Number, and add them together, then th Sum is the Value required.

So 8*s.* 6*d.* will be divided into 6*s.* and 2*s.* 6*d.* a the price of the given Number may be found out as fore, &*c.* Examples follow.

yds s. d.
386 at 8—8

$\frac{1}{3}$ | 128*l.* —13—4
$\frac{1}{10}$ | 38 —12—0

167 l. 5s. 4d. *facit*

ells s. d.
s. | 540 at 5—4

2 | 54——0
$\frac{1}{6}$ | 90——0

144 l. *facit.*

ells s. d.
s. | 427 at 8—6

6 | 128 l. —2—0
$\frac{1}{8}$ | 53——7—6

181 l. 9s. 6d. *facit*

yds s. d.
s. | 386 at 14—8

8 | 154 l. —8—0
$\frac{1}{3}$ | 128 —13—4

283 l. 1s. 4d. *facit*

17. When the given price of an Integer is Shillings nd Pence, and you cannot readily divide them according- ng to the laſt Rule, then multiply the given Number, hoſe Value you ſeek, by the Number of Shillings in he price of the Integer, and then for the Pence work by he 8th Rule foregoing; then add the Numbers together, nd their Sum is the Value ſought in Shillings; as for xample, What is the Value of 392 *yds.* at *6s. 9d. per* . Here *6s. 9d.* cannot be made an even part, nor indeed an it be divided into even parts of a Pound; wherefore multiply the given Number of *yds* 392 by *6* for the *6s.* e Product is 2352 Shillings, then for the *9d.* I divide into *6d.* and *3d.* and work for 'em by the 8th Rule regoing, and at laſt add the Shillings together, they ake 2646*s.* and by the 3d they are reduced to 132*l.* 6*s.* e Value of 392 *yds.* at *6s. 9d. per yd.* See the Work.

——392 yds at 6 s. 9 d.

2352
$\frac{1}{2}$ | 196
$\frac{1}{4}$ | 98

264|6

132 l. 6 s. *facit.*

In like manner variety of other Examples may be wrought.

18. When the given price of the Integer is Shillings, Pence and Farthings, then multiply the given Number of Integers by the Number of Shillings contain'd in the Value of the Integer, and for the Pence and Farthings follow the 10th Rule of this Chapter.

Examples.

yds. *s.* *d.*
438 *at* 8——6¾
s. 8 | 3504
½ | 219
½ | 27—4½*d.*
375|0—4½
fac. 187 *l.* 10 *s.* 4½*d.*

ells *s.* *d.*
136 *at* 9——2½
s. 9 | 1224——0
⅙ | 22——8
¼ | 5——8
125|0——4
fac. 62 *l.* 12 *s.* 4 *d.*

ells *s.* *d.*
370 *at* 14——2¾
1480
s. 370
14 | 5180 *d.*
¼ | 61——8
¼ | 15——5
½ | 7——8½
526|4——9½
fac. 263 *l.* 4 *s.* 9½ *d.*

ells *s.* *d.*
431 *at* 2——4½
2 | 862
¼ | 107——9 *d.*
⅛ | 53——10½
102|3——7½
facit 51 *l.* 3 *s.* 7½ *d.*

Caſe 6.

19. When the given Value of the Integer is Pounds, then multiply the Number of Integers whoſe Value is ſought by the price of the Integer, and the Product is the Anſwer in Pounds.

Examples.

C. l.
42 at 2 per C.
48 l. facit

C. l.
13 at 8 per C.
104 l. facit

C. l.
30 at 3 per C.
90 l. facit

C. l.
48 at 12 per C.
376 l. facit.

Caſe 7.

20. If the price of the Integer is Pounds and Shillings, then for the Pounds work as in the laſt Rule, and for the Shillings as in the 12th and 13th Rules beforegoing, then add the Numbers produc'd from them both, and the Sum is the Value ſought.

Examples.

	C. l.
	46 at 2——41
2l.	92 s.
4s	9——4
	101 l. 4 s. facit

	groſs l. s.
	82 at 4——10
4l.	328
10s.	41
	369 l. facit

	groſs l. s.
	58 at 3——7
3l	174 s.
6s	17—— 8
1s	2——18
	194 l. 6 s. facit

	groſs l. s.
	26 at 3——15
3l.	78
14s.	18——4
1s.	1——6
	97 l. 10 s. facit

21. When the given price of an Integer conſiſts of Pounds, Shillings and Pence, with Farthings, then work for the Shillings, Pence and Farthings, firſt according to the 18th Rule of this Chapter, and find the Total Value of the given Number, as if there were no Pounds, then work with thePounds according to the 19th Rule of this Chapter, and add the Numbers thus found, and their Sum is the Total Value required.

Examples of this Rule follow.

C *l.* *s.* *d.*
213 *at* 1—13—4 ½
639
213
13 *s.* 2769 *d.*
d. 53—3
1 ½ *d.* 26—7 ½
284|8—10½
1 *l.* 142 *l.* 08*s.* 10 ½ *d.*
213—
355*l.* 8*s.* 10½ *d.* *facit*

C *l.* *s.* *d.*
37 *at* 3—8—10 ½
296 *d.* 8 *s.*
18—6 6 *d.*
9—3 3 *d.*
4—7 ½ 1 ½ *d.*
32|8—0½ *d.*
16 *l.* 8 *s.* 4½ *d.*
111 3 *l.*
127 *l.* 8 *s.* 4 ½ *d.* *fac*

groſs *l.* *s.* *d.*
416 *at* 2—9—3¾
9 *s.* 3744
3 *d.* 104
¾ *d.* 26
387|4
193 *l.* 14 *s.*
2 *l.* 832
1025 *l.* 14*s.* *facit*

groſs *l.* *s.* *d.*
48 *at* 3—15—11½
240
48
720 15 *s.*
24 6 *d.*
16 4 *d.*
6 1½ *d.*
76|6
38—6
144 3 *l.*
182 *l.* 6 *s.* *facit.*

22. When there is given the Value of an Integer, and it is required to know the Value of many ſuch Integers together, with $\frac{1}{4}$ or $\frac{1}{2}$ or $\frac{3}{4}$ of an Integer, then firſt (by the former Rules) find out the Value of the given Number of Integers, and then for $\frac{1}{4}$ of an Integer take $\frac{1}{4}$ of the given Value of the Integer, or for $\frac{1}{2}$ take $\frac{1}{2}$ of the given Value of the Integer, and for $\frac{3}{4}$ firſt take half of the given Value, and then half of that half, ſetting each part under the precedent, then adding them together, their Sum will be the required Value of the Integers and their parts. *Example,* What is the Value of 116$\frac{1}{2}$ yards, at 4*s.* 6*d.* *per Yard* ? To give an Anſwer, Firſt I work for the Value of 116 yds. by the 15th Rule foregoing, and then for the half yds. I take half of 4*s* 6*d.* which is 2*s.* 3*d.* and add to the reſt found as before, then is that Sum the total Value of 116$\frac{1}{2}$ yds. at 4*s.* 6*d.* *per* yard, which I find to amount to 26*l.* 4*s.* 3*d.* as by the Work in the Margent. And all other Examples of this kind, are wrought the ſame way.

yds. s. d.
116$\frac{1}{2}$ at 4—6

11 l. 12 s. | 2s.
14 l. 10 d. | 2s. 6d.
2—3 | $\frac{1}{2}$ yards

26—4—3 *facit*

Many more Queſtions might be ſtated, and ſeveral other *Rules of Practice* may be ſhewn according to the Method of divers Authors ; but what have been delivered here, are ſufficient for the Practical Arithmetician in all Caſes whatſoever.

CHAP. XXVII.

The Rule of Barter.

1. BARTER, is a Rule among Merchants, which (in the Exchanging of one Commodity for another) informs them ſo to proportion their Rates, as that neither may ſuſtain Loſs.

2. To reſolve Queſtions in *Barter*, it will not be difficult to him that is acquainted with the *Golden Rule*, or *Rule of Three*, it being altogether uſed in reſolving ſuch Queſtions.

Queſt. 1. Two Merchants, (*viz.* A and B) Barter, A hath 13 *C.* 3 *qrs.* 14 *l.* of Pepper, at 2*l.* 16*s.* *per C.* and B hath Cotton at 9 *d. per l.* I demand how much B muſt give A for his Pepper?

Anſwer, 9 *C.* 1 *qr.*

Firſt find by the Rule of Three, or the Rules of Practice foregoing, how much the Pepper is worth, ſaying,

If 1 *C.* coſt 2*l.* 16*s.* what will 13 *C.* 3 *qrs.* 14 *l.* coſt?

Anſwer, 38*l.* 17*s.*

Secondly, By the *Rule of Three*, ſay, If 9*d.* buy 1 *l.* of Cotton, how much will 38*l.* 17*s.* buy ?

Anſwer, $9\frac{1}{4}$ *C.* and ſo much Cotton muſt B give to A for 13 *C.* 3 *qrs.* 14 *l.* of Pepper, at 2*l.* 16*s.* *per Cent.* when the Cotton is worth 9*d.* *per l.*

Queſt. 2. A and B barter, A hath 120 Yards of Broad-cloth, worth 6*s.* *per* Yd, but in the Barter he will have 1*s.* *per* yard ; B hath Shalloon worth 4*s.* *per* yard. Now I demand how many yards of Shalloon B muſt give A for his Broad-cloth, making his Gain in Barter equal to that of A?

Anſwer, 110 Yards of Shalloon.

Firſt (as in the laſt Queſtion) find out how B ought to ſell his Shalloon in Barter, *viz.* ſay, If 6*s.* require 8*s.* what will 4*s.* require?

Anſwer, 5*s.* 4*d.*

Thus you ſee that B muſt ſell his Shalloon in Barter at 5*s.* 4*d.* if A ſell his Broad-cloth at 8*s.* *per* yard.

It remaineth now to find out how much Shalloon B muſt give for 120 Yards of Broad-cloth, which reſolved after the Method in the 18th Queſtion of this Chapter is found to be 180, and ſo many yds of Shalloon muſt B give A for the 120 yds of Broad-cloth.

Queſt. 3. A and B bartered, A had 14 *C.* of Sugar worth 6*d.* *per l.* for which B gave him 1 *C.* 3 *qrs.* of Cinnamon, I demand how B rated his Cinnamon *per l.*

Anſwer, 4*s*. *per l*.

Queſt. 4. A and B barter, A hath 4 Tun of Brandy, worth 37*l*. 16*s*. ready Money, but in Barter he hath 50*l*. 8*s*. *per* Tun, and giveth B 21 C. 2 *qrs*. $11\frac{1}{5}$ l. of Ginger for the 4 Tun of Brandy, I deſire to know how much B ſold his Ginger in Barter *per C*. and how much it was worth in ready Money?

Anſwer, For 9*l*. 6*s*. 8*d*. in Barter, and it is worth 7*l*. *per Cent*. in ready Money.

Queſt. 5. A and B barter, A hath 320 Dozen of Candles, at 4*s*. 6*d*. *per* Dozen, for which B giveth him 30 *l*. in Money, and the reſt in Cotton at 8*d*. *per l*. I demand how much Cotton he muſt give him more than the 30 *l*.

Anſwer, 11 *C*. 1 *qr*.

CHAP. XXVIII.

Queſtions in Loſs and Gain.

Q. 1. A Merchant bought 436 Yards of Broad-cloth for 8*s*. 6*d*. *per* yd, and ſelleth it again at 10*s*. 4*d*. *per* yard; now I deſire to know how much he gained in the 436 Yards?

Anſwer, 39*l*. 12*s*. 4*d*.

Firſt, find out by the Rule of Three, or by Practice, how much the Cloth coſt him at 8*s*. 6*d*. *per* yard, which I find to be 185*l*. 6*d*. then by the ſame Rule find out how much he ſold it for, *viz*. 225*l*. 5*s*. 4*d*. then ſubtract 185*l*. 6*s*. which it coſt him, from 225*l*. 5*s*. 4*d*. which he ſold it for, and there remaineth 39*l*. 19*s*. 4*d*. for his Gain in the Sale thereof.

Otherwiſe, it may ſooner be reſolv'd thus, firſt find out how much he gain'd *per yd*. *viz*. Subtract 8*s*. 6*d*. which he gave per yard, from 10*s*. 4*d*. which he ſold it for per yard, the Remainder 1*s*. 10*d*. for his Gain per yard. Then ſay,

If 1 yard gain 1s. 10d. what will 435 yards gain? The Anſwer, by Practice or the Rule of Three, is 39l. 19s. 4d. as was found before.

Queſt. 2. A Draper bought 124 yds. of Holland-cloth, for which he gave 31*l.* I deſire to know how he muſt ſell it *per* yd. to gain 10*l.* 6*s.* 8*d.* in the whole Sale of 124 Yards? *Anſwer*, At 6*s.* 8*d.* *per* yd.

Add the Price which it coſt him (*viz.* 31*l.*) to his intended Gain, (*viz.* 10*l.* 6*s.* 8*d.*) the Sum is 41*l.* 6*s.* 8*d.* Then ſay,

If 124 yds. require 41*l.* 6*s.* 8*d.* what will 1 yard require? By the *Rule of Three*, I find the Anſwer, 6*s.* 8*d.*

Queſt. 3. A Grocer bought 3 *C.* 1 *qr.* 14 *l.* of Cloves, which coſt him 2*s.* 4*d.* *per l.* and ſold them for 52*l.* 14*s.* I deſire to know how much he gain'd in the whole? *Anſwer*, 8*l.* 12*s.*

Queſt. 4. A Draper bought 86 Kerſeys for 129*l.* I demand how he muſt ſell them *per* Piece to gain 15*l.* in laying out 100*l.* at that Rate? *Anſwer*, 1*l.* 14*s.* 6*d.* *pe* piece; for,

As 100 *l.* is to 115*l.* ſo is 129*l.* to 148*l.* 7*s.*

So that by the Proportion above, I have found how much he muſt receive for the 86 Kerſeys to gain afte the Rate of 15*l.* *per C.* Then to find how he muſt ſel them *per* piece, I ſay,

As 86 pieces are to 448*l.* 7*s.* ſo is 1 piece to 1*l.* 14 6*d.* which is the Number ſought.

Queſt. 5. A Grocer bought $4\frac{1}{4}$ *C.* of Pepper for 15 17*s.* 4*d.* and (it proving to be damnify'd) is willing t loſe 12*l.* 10*s.* *per Cent.* I demand how he muſt ſell i *per l.*? *Anſwer*, 7*d.* *per l.*

Subtract 12*l.* 10*s.* the Loſs of 1000*l.* from 100*l.* an there remains 87*l.* 10*s.* Then ſay,

As 100*l.* is to 87*l.* 10*s.* ſo is 15*l.* 17*s.* 4*d.* to 13*l.* 17 8*d.* ſo much as he muſt ſell it all for, to loſe after th Rate propounded: Then to know how he muſt ſell i *per l.* I ſay,

As 13*l.* 17*s.* 6*d.* is to $4\frac{1}{4}$ *C.* ſo is 1*l.* to 7*d.*

Queſt. 6. A Plummer ſold 10 Fodder of Lead (th Fodder containing $19\frac{1}{2}$ *C.*) for 204*l.* 15*s.* and gaine after the Rate of 12*l.* 10*s.* *per* 100*l.* I demand ho much it coſt him *per C.*? *Anſwer*, 18*s.* 8*d.*

To reſolve this Queſtion, add 12*l.* 10*s.* (the Gain *per Cent.*) to 100*l.* and it makes 112*l.* 10*s.* then ſay,

As 112*l.* 10*s.* is to 100*l.* ſo is 204*l.* 15*s.* to 182*l.*

Which 182*l.* is the Sum it coſt him in all; then reduce your 10 Fodders to Half Hundreds, and it makes 390. Then ſay,

As 390 half Hundreds is to 182*l.* ſo is 2 half Hundreds to 18*s.* 8*d.* the price of two half Hundreds, or 1 *C. wt.* and ſo much it ſtood him in *per C. wt.*

Queſt. 7. A Merchant bought eight Tun of Wine, which being ſophiſticated, he ſelleth for 400*l.* and loſeth after the Rate of 12*l.* in receiving 100*l.* Now I demand how much it coſt him *per* Tun? And how he ſelleth it *per* Gallon to loſe after the ſaid Rate? *Anſwer*, It coſt him 56*l. per* Tun, and he muſt ſell it at 3*s.* 11*d.* $2\frac{10}{21}$ *qrs. per* Gallon to loſe 12*l.* in receiving 100*l.*

To reſolve this Queſtion, I conſider that in the firſt place, that in receiving 100*l.* he loſeth 12*l.* therefore 100*l.* comes in for 112*l.* laid out; wherefore to find out how much he laid out for the whole, I ſay,

As 100*l.* is to 112*l.* ſo is 400*l.* to 448*l.* and ſo much the 8 Tun coſt him: Then to find how much it coſt *per* Tun, I ſay,

As 8 is to 448*l.* ſo is 1 to 56*l.* the Price it coſt *per* Tun.

Now to find how he muſt ſell it *per* Gallon, reduce the 8 Tuns into Gallons, they make 2016. Then ſay,

As 2016 Gallons is to 400*l.* ſo is 1 Gallon to 3*s.* 11*d.* $2\frac{10}{31}$ *qrs.* the price he muſt ſell it at *per* Gallon to loſe as aforeſaid.

Queſt. 8. A Merchant bought eight Tuns of Wine, which being ſophiſticated, he is willing to ſell for 400*l.* and loſeth at that Rate 12*l.* in laying out 100*l.* upon the ſame, now I demand how much it coſt him *per* Tun?

Here I conſider that for 100*l.* laid out, he received but 88*l.* wherefore to find what 8 Tuns coſt him, I ſay, As 88l. is to 100l. ſo is 400l. to $454\frac{6}{11}$ the Price it all coſt him; then to find how much per Tun, I ſay,

As 8 is to $454\frac{6}{11}$ ſo is 1 to $56\frac{9}{11}$ or 56 l. 16 s. 4d. $1\frac{5}{11}$ qrs. per Tun.

C H A P. XXIX.

Equation of Payments.

1. EQuation of Payments is that Rule amongſt Merchants whereby we reduce the Times for Payments of ſeveral Sums of Money to an equated Time for Payment of the whole Debt, without Damage to Debtor or Creditor; and,

The Rule is,

2. Multiply the Sums of each particular Payment by its reſpective Time, then add the ſeveral Products together, and their Sum divide by the Total Debt, and the Quotient thence ariſing is the Equated Time for the payment of the whole Debt *Example.*

Queſt. 1. A is indebted to B in the Sum of 130l. whereof 50 l. is to be paid at 2 Months, and 50 l. at 4 Months, and the reſt at 6 Months, now they agree to make one payment of the total Sum; the Queſtion is, What is the Equated Time for payment, without Damage to Debtor or Creditor?

To reſolve this Queſtion, I multiply each Payment by its Time, *viz.*

50 l. Multiply'd by 2 Mon. produceth ——— 100
50 l. Multiply'd by 4 Mon. produceth ——— 200
30 l. Multiply'd by 6 Mon. produceth ——— 180

The Sum of the Product, is ——— 480

Then I divide 480 (the Sum of the product) by 130 (the total Debt) and the quotient is $3\frac{9}{12}$ Months for the time of paying the whole Debt.

Queſt. 2. A Merchant hath owing him 1000 l. to be paid as followeth, *viz.* 600 l. at 4 Months, 200 l. at 6 Months, and the reſt (which is 200 l. at 12 Months) and he agreeth with his Debtor to make one payment of the whole, I demand the Time of Payment without Damage to Debtor or Creditor?

600 l. Multiply'd by 4 Months is ——— 2400
200 l. Multiply'd by 6 Months is ——— 1200
200 l. Multiply'd by 12 Months is ——— 2400

The Sum of the product is—6000

and the Sum of the products (6000) being divided by the whole Debt (1000 l.) quotes 6 Months for the Time of payment of the whole Debt.

3. The Truth of this Rule is thus manifeſt, if the Intereſt of that Money which is paid (by the equated Time) after it is due, be equal to the Intereſt of that Money (which by the equated Time) is paid ſo much ſooner than it is due at any Rate per C. then the Operation is true, otherwiſe not. Example.

The Proof of the Rule of Equation of Payments.

In the laſt Queſt. 600 l. ſhould have been paid at 4 Months, but is not diſcharged till 6 Months (that is, 2 Months after it is all due) wherefore its Intereſt or 2 Months at 6 per Cent. per Hun. is 6l. and then 200 l. was to be paid at 6 Months, which is the equated Time for its Payment, therefore no Intereſt is reckon'd for it; but 200 l. ſhould have been paid at 12 Months, but is paid at 6 Months, which is 6 Months ſooner than it ought, wherefore the Intereſt of 200 l. for 6 Months, is 6l. (accompting 6 l. per Cent. per Annum) which is equal to the Intereſt of 600l. for 2 Months, wherefore the Work is right.

Q. 3. A Merchant hath owing him a certain Sum to be diſcharged at 3 equal Payments, *viz.* $\frac{1}{3}$ at two Months, $\frac{1}{3}$ at four Months, and $\frac{1}{3}$ at eight Months, the Queſtion is, What is the equated Time for the payment of the whole Debt?

In Queſtions of this Nature (viz. where the Debt is divided into equal or unequal parts) each of its Parts is to be multiply'd by its Time, and the Sum of the product is the Anſwer.

$\frac{2}{3}$ *Multiply'd by* 2 *Mon. produceth* $\frac{7}{8}$
$\frac{1}{3}$ *Multiply'd by* 4 *Mon. produceth* $1\frac{1}{3}$
$\frac{1}{3}$ *Multiply'd by* 8 *Mon. produceth* $2\frac{2}{4}$

The Sum of the Product is $4\frac{2}{3}$

which is $4\frac{2}{3}$ Months for the Equated Time of Payment.

If inſtead of the Fractions repreſenting the parts, you had wrought by the Numbers themſelves (repreſented by thoſe parts) according to the firſt and 2d *Example*, it would have been the ſame Anſwer; and ſuppoſe the Debt had been 90*l.* then $\frac{1}{3}$ of it is 30*l.* for each payment, *viz.* at 2, 4, and 8 Months. Then

30*l. Multiply'd by* 2 *Mon. produceth* 60
30*l. Multiply'd by* 4 *Mon. produceth* 120
30*l. Multiply'd by* 8 *Mon. produceth* 240

The Sum of the Product is 420

which divided by 90 (the whole Debt) quoteth $4\frac{60}{90}$ or $4\frac{2}{3}$ Months, as before.

Q. 4. A Merchant oweth a Sum of Money to be paid $\frac{1}{2}$ at 5 Months, and $\frac{1}{4}$ at 8 Months, and $\frac{1}{4}$ at 10 Months, and he agreeth with his Creditor to make one total payment; I demand the time without damage to Debtor and Creditor? Work as in the laſt Queſtion, and you will find the Anſwer to be 7 Months.

Q. 5. A is indebted to B 640*l.* whereof he is to pay 40*l.* preſent Money, 350*l.* at 3 Months, and the reſt (*viz.* 250*l.*) at 8 Months, and they agree to make an equated Time for the whole payment; now I demand the Time?

In Queſtions of this Nature, (*viz.* where there is ready Money paid) you are in Multiplying to neglect the Money that is to be paid preſent, and work with the reſt, as is before directed, and divide the Sum of the products by the whole Debt, and the Quote is the Anſwer; for here 40*l.* is to be paid preſent, and hath no Time allowed; and according to the Rule it ſhould be multiplied by its Time, which is (0); therefore 40 Times 0 is 0, which neither augmenteth nor diminiſheth the Dividend; wherefore to proceed (according to Direction) I ſay,

350 *by* 3 *Months produceth* ——— 1050
250 *by* 8 *Months produceth* ——— 2000

The Sum of the Product is 3050

which divided by 640, the whole Debt, the Quote is $4\frac{49}{64}$ Months, the Time of Payment.

Q. 6. A is indebted to B in a certain Sum, half whereof is to be paid preſent Money, one third at 6 Months, and the reſt at 8 Months, now I demand the equated Time for payment of it all?

Anſwer, $3\frac{1}{3}$ Months is the Time of Payment.

Q. 7. A is indebted to B 120*l.* whereof $\frac{1}{3}$ is to be paid at 3 Months, $\frac{1}{4}$ at 6 Months, and the reſt at 9 Months; What is the equated Time for the payment of the whole Sum?

Anſwer, At 6 Months.

Q. 8. A is indebted to B 420*l.* which is due at the end of 6 Months, but A is willing to pay him 140*l.* preſent, provided he can have the Remainder forborn ſo much the longer to make Satisfaction for his Kindneſs; which is agreed upon; I deſire to know what Time ought to be allotted for the payment of the 280*l.* remaining?

The Operation of this Queſtion is left to the Learner, to try his Genius; and who, in this Caſe, muſt have an Eye to the Rule of Three.

CHAP. XXX.

EXCHANGE.

1. THE Rule of Exchange informeth Merchants how to exchange Monies, Weights, or Meaſures of one Country into (or for) the Monies, Weights or Meaſures of another Country, and when the Rate, Reaſon or Proportion betwixt the Money, Weights or Meaſures of different Countries is known, it will not be difficult of the Practitioner that is well-acquainted with the Rule for Proportion (or Rule of Three) to reſolve any Queſtion, wherein it is requir'd

to exchange a given Quantity of the one kind into the ſame Value of another kind.

2. In Queſtions of Exchange there is always a Compariſon made between the Coyns, *&c.* of two Countries (or Kinds) or more.

3. In Queſtions where there is a Compariſon made between 2 Things, (whether they be Monies, Weights, *&c.*) of different Kinds, there may be a Solution found by a ſingle Rule of Three, as by the following Example.

Queſt. 1. A Merchant at London deliver'd 370l. Sterl. to receive the ſame at Paris in French Crowns; the Exchange $3\frac{1}{3}$ French Crowns per l. Sterl. I demand how many French Crowns he ought to receive?

In placing the Numbers, obſerve the 6th Rule of the 11th Chapter, which being done, the given Numbers will ſtand thus:

l.	Crowns	l.
1	$3\frac{1}{3}$	370

and being reduc'd according to the Rules of the 12th Chapter will ſtand thus:

As $\frac{1}{1}$ is to $\frac{10}{3}$, ſo is $\frac{370}{1}$ to $1233\frac{1}{3}$.

So that I conclude he ought to receive $1233\frac{1}{3}$ French Crowns at Paris for his 370 l. delivered at London.

Queſt. 9. A Merchant deliver'd at Amſterdam 587 l. Flemiſh to receive the Value thereof at Naples in Ducats, the exchange $4\frac{4}{5}$ Ducats per Flemiſh. I demand how many Ducats he ought to receive?

The Proportion is as followeth.

l.	Ducats	l.	Ducats

As 1 is to $\frac{24}{5}$, ſo is $\frac{587}{1}$ to $2817\frac{3}{5}$.

So I find he ought to receive $2817\frac{3}{5}$ Ducats at Naples for the 387 l. Flemiſh deliver'd at Amſterdam.

Queſt. 3. A Merchant at Florence delivereth 2478 Ducatoons, to receive the Value at London in Pence, the Exchange at $53\frac{1}{2}$ d. Sterl. per Ducatoon; I demand how much Sterling he ought to receive?

The proportion for Reſolution is,

Duc.	d.	Duc.	d.

As $\frac{1}{1}$ is to $\frac{107}{2}$, ſo is $\frac{2478}{1}$ to 186073 which is equal to 775l. $6\frac{1}{2}$ for the anſwer.

4. When there is a Compariſon made between more than two different Coins, Weights, or Meaſures, there ariſeth ordinarily two different Caſes from ſuch a Compariſon.

1. When it is required to know how many pieces of the firſt Coin, Weight or Meaſure are equal in Value to a known Number of pieces of the laſt Coin, Weight or Meaſure.

2. When it is required to find out how many pieces of the laſt Coin, Weight or Meaſure, are equal in Value to a given Number of the firſt ſort of Coin, Weight or Meaſure.

An Example of the Caſe may be this, viz.

Q. 4. If 150 pence at London are equal to 3 Ducats at Naples, and $4\frac{4}{5}$ Ducats at Naples, make $34\frac{1}{2}$ Shillings at Bruſſels; then how many pence at London are equal to 139 s. at Bruſſels? *Facit* 960 d.

The Queſtion may be reſolved by two Single Rules of Three: For firſt, I ſay,

If $\frac{3}{1}$ Ducats at Naples make 150 d. at London, how many pence will $4\frac{4}{5}$ Ducats make? *Anſwer*, 240 d.

By the foregoing proportion we have diſcovered that $4\frac{4}{5}$ Ducats at Naples make 240 pence at London; And by the Tenor of the Queſtion we ſee that $4\frac{4}{5}$ Ducats at Venice make $35\frac{1}{2}$ Shill. at Bruſſels, therefore 240 d. at London are equal to $34\frac{1}{2}$ s. at Bruſſels, (for the Things that are equal to one and the ſame Thing are alſo equal to one another) wherefore we have a way laid open to give a Solution to this Queſtion by another Single Rule of Three, whoſe proportion is,

As $34\frac{1}{2}$ s. at Bruſſels is to 240 d. London, ſo is 131s. at Bruſſels to 960 d. at London; which is the Anſwer to the Queſtion.

An Example of the ſecond Caſe may be thus, viz.

Queſt. 5. If 40 l. Averdupois-weight at London is equal to 36 l. Weight at Amſterdam, and 90 l. at Amſterdam makes 116 l. at Dantzick, then how many pounds at Dantzick, are equal to 112 l. Averdupois-weight at London? *Anſwer*, $129\frac{23}{25}$ l. at Dantzick.

This Queſtion is likewiſe anſwered by two ſingle Rules of Three, viz. Firſt, I ſay,

As 36*l.* at *Amſterdam* is to 40*l.* at *London*,
So is 90*l.* at *Amſterdam* to 100*l.* at *London.*

And by the Queſtion you find that 90*l.* at *Amſterdam* is 116*l.* at *Dantzick*; and therefore 100*l.* at *London* is likewiſe equal thereunto, wherefore again I ſay,

As 100*l.* at *London* is to 116*l.* at *Dantzick*,
So is 112*l.* at *London* to $12\frac{9}{1}\frac{2}{2}\frac{3}{5}$ *l.* at *Dantzick.*

By which I find that $129\frac{23}{25}$ *l.* at *Dantzick* are equal to 112*l.* *Averdupois-weight* at *London.*

5. There is a more ſpeedy way to reſolve ſuch Queſtions as are contained under the two Caſes before-mentioned, laid down by Mr. *Kerſey* in the 3d Chapter of his Appendix to *Wingate*'s Arithmetick, where he hath given two Rules for the Reſolution of the Queſtions pertinent to the two ſaid Caſes.

6. But I ſhall lay down a general Rule for the Solution of both Caſes; and 1ſt, Let the Learner obſerve the following Directions in placing of the given Terms, *viz.*

7. Let there be made two Colums, and in theſe Columns, ſo place the given Terms one over the other, as that in the ſame Column there may not be found two Terms of the ſame Kind one with the other.

Having thus placed the Terms, the general Rule is,

Obſerve which of the ſaid Columns hath the moſt Terms placed in it, and multiply all the Terms therein continually, and place the laſt Product for a Dividend; then multiply the Terms in the other Column continually, and let the laſt product be a Diviſor, then divide the ſaid Dividend by the ſaid Diviſor, and the Quotient thence ariſing will be the Anſwer to the Queſtion.

So the Example of the firſt of the ſaid Caſes being again repeated, *viz.* If 150 pence at *London* make three Ducats at *Naples*, and $4\frac{4}{5}$ Ducats at *Naples* make $34\frac{1}{2}$ Shillings at *Bruſſels*, then how many pence at *London* are equal to 138 Shillings at *Bruſſels*?

The Terms being placed according to the 7th Rule, will ſtand as followeth:

	A	B	
Pence at Lond.	150	3	Ducats at Naples
Ducats at Nap.	$4\frac{4}{5}$	$34\frac{1}{2}$	Shillings at Bruſſels
Shill. at Bruſſ.	138		

Having thus placed the Terms, that in neither Column there is two Terms of one Kind, then obſerve that the Column under A hath moſt Terms in it, therefore they muſt be multiplied together for a Dividend, *viz.* 150 multiply'd by $4\frac{4}{5}$ produceth $\frac{3600}{5}$, which multiply'd by 138, produceth $\frac{496800}{5}$ for a Dividend, then in the Column under B there are 3, and $34\frac{1}{2}$, which multiply'd together, produce $\frac{207}{2}$ for a Diviſor, then having divided $\frac{496800}{5}$ by $\frac{207}{2}$ the Quotient is 960 Pence for the Anſwer, as before.

Again, Let the Example of the ſecond Caſe be again repeated, *viz.* If 40*l.* *Averdupois weight* at *London* make 36 *l.* Weight at *Amſterdam*, and 90 *l.* at *Amſterdam* make 116 at *Dantzick*, then how many pounds at *Dantzick* are equal to 112 *l.* *Averdupois-weight* at *London* ?

The Terms being diſpos'd according to the 7th Rule foregoing, will ſtand thus :

	A	B	
l. *at* Lond.	40	36	*l.* *at* Amſterdam
l. *at* Amſt.	90	116	*l.* *at* Dantzick
		112	*l.* *at* London.

whereby I find that the Terms under B multiply'd together produce 467712 for a Dividend, and the Terms under A, *viz.* 40 and 90 produce 3600 for a Diviſor, and Diviſion being finiſhed, the Quotient giveth 129 $\frac{3312}{3600}$ Pounds *Dantzick* for the Anſwer.

Chap. XXXI. *Single Poſition.*

1. NEGATIVE Arithmetick, called the Rule of Falſe, is that by which we find out a Truth, by Numbers invented or ſuppos'd, either Single or Double.

2. The Rule of Single Poſition, is, when at once, *viz.* by one falſe Poſition, or feign'd Number, we find out the true Number ſought.

3. In the Single Rule of Falſe, when you have made choice of your Poſition, work it according to the Tenor of the Queſtion, as if it were the true Number ſought, and if by the ordering your Poſition you find either the Reſult too much or too little, you may then find out the Number ſought by this proportion following, *viz.*

As the Reſult of your Poſition is to the Proportion, ſo is the given Number ſought. *Example.*

Queſt. 1. A Perſon having about him a certain Number of Crowns, ſaid, If a 4th, 3d & 6th of them were added together, they would make juſt 45l. now I demand the number of Crowns he had about him? *Anſ.* 60 Crowns.

To reſolve this Queſtion, I ſuppoſe he had 24 Crowns (or any other Number that will admit of the like Diviſion) now the fourth of 24 is 6, and the 3d is 8, and the 6th is 4, all which Parts, (*viz.* 6, 8 and 4) being added together, make but 18, but it ſhould be 45, wherefore I ſay by the Rule of Three,

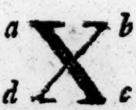
As 18 the Sum of the Parts is to the Poſition 24, ſo is 45 the given number to 60, the true Number ſought.

For the 4th of 60 is 15, and the 3d of 60 is 20, and the 6th of 60 is 10, which added together make 45.

CHAP. XXXII. *Double Poſition.*

1. THE Rule of Double Poſition, is, when two falſe Poſitions are aſſum'd to give a Reſolution to the Queſtion propounded.

2. When any Queſtion is ſtated in Double Poſition, make ſuch a Croſs as in the Margent.



3. Then make choice of any Number you think may be convenient for your working, which call your firſt Poſition, and place it at the end of the Croſs at *a*, then work with this Poſition, as if it were the true number ſought, according to the nature of your Queſtion, then having found out your Error, either too much or too little, place it on that ſide the Croſs *d*, then make choice of another Number of the ſame Denomination with the firſt Poſition (which call your 2d poſition) and place it on that ſide of the Croſs at *b*, then work with this poſition as with the former, and having found out your Error, either too much or too little, place it on that ſide of the Croſs at *c*, and then the poſitions will ſtand at the Top of the Croſs, and the Errors in the Bottom, each under his correſpondent poſition, and then multiply the

Errors into the poſition croſs wiſe, that is, multiply the firſt poſition by the 2d Error, and the 2d poſition by the firſt Error, and put each product over its poſition.

4. Having proceeded ſo far, then conſider whether the Errors were both alike; that is, whether they were both too much, or both too little, and if they are alike; then ſubtract the leſſer product from the greater, and ſet the Remainder for a Dividend, then ſubtract the leſſor Error from the greater, and let the Remainder be a Diviſor, then the Quotient ariſing by this Diviſion is the Anſwer to the Queſtion.

5. But if the Errors are unlike, that is, one too much, and the other to little, then add the products of the poſitions and Errors together, and their Sum ſhall be a Dividend, then add the Errors together, and their Sum ſhall be a Diviſor, and the Quotient ariſing hence is the Anſwer.

Queſt. 1. A, B, and C built a Houſe which coſt 76 l. of which A paid a certain Sum unknown, B paid as much as A, and 10 l. over, and C paid as much as A and B; now I deſire to know each Man's Share in that Charge?

Having made a Croſs according to the ſecond Rule, I come according to the third Rule to make choice of my firſt poſition, and here I ſuppoſe A paid 6l. which I put upon the Croſs as you ſee, then B paid 16l. (for its ſaid he paid 10 l. more than A) and C paid 22 l. for its ſaid he paid as much as A and B, then I add their parts.

l.		l.
9		A 6
19		B 16
28	120 168 288	C 22
—	6 X 9	—
56	2) (14	Sum 44
	32 X 20	
76	12	76
56		44
—		—
20		Error 32

And they amount to 44, but it is ſaid they paid 76*l.* wherefore there is 32 too little, which I note down at the Bottom of the Croſs under its Poſition for the firſt Error.

2dly, I ſuppoſe A paid 9*l.* then B paid 19*l.* and C 28*l.* all which added together makes 56, but they ſhould make 76, wherefore the Error of this Poſition is 20, which I put at the Bottom of the Croſs under its Poſition for the 2d Error, then I multiply the Errors and Poſitions croſs-wiſe, *viz.* 32 (the Error of the firſt Poſition) by 9 (the 2d Poſition) and the Product is 120.

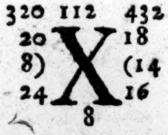
Then (according to the 4th Rule) I ſubtract the leſſer Product from the greater, *viz.* 120 from 288, becauſe the Errors are both alike, (*viz.* too little) and there remaineth 168 for a Dividend, then I ſubtract 29 (the leſſor Error) from 32, the greater Error, and the Remainder is 12, for a Diviſor, then I divide 168 by 12, and the Quotient is 14 for the Anſwer, which is the Share of A in the Payment.

6. Again 2dly, If the Errors had been both too big, it had had the ſame Effect as appeareth by the following Work; for firſt, I ſuppoſe A paid 20*l.* then B paid 30*l.* and C 50*l.* which in all is 100*l.* but it ſhould have been no more than 76, wherefore the firſt Error is 24 too much. Again, I ſuppoſe A paid 18*l.* then B muſt pay 28*l.* and C muſt pay 46*l.* which in all

20 A
30 B
50 C

100 *Sum*
76 *Subtr.*

24 *Error*



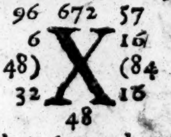
A 18
B 28
C 46

Sum 92
Subtr. 76

Error 16

is 92*l.* but it ſhould have been but 76*l.* wherefore the 2d Error is 16 too much, then I multiply 20 (the firſt Poſition) by 16 (the ſecond Error) and the Product is 320; again, I multiply 18 (the 2d poſition) by 24 (the firſt Error) and the Product is 432. Then becauſe the Errors are both too much, I ſubtract 320 (the leſſer Product) from 432 (the greater product) and there remaineth 112 for a Dividend; likewiſe I ſubtract 16 (the leſſer Error) from 33 (the greater Error) and the Difference is 8 for a Diviſor, then perform Diviſion, and the Quotient is 14 (as before) for the Anſwer.

Again, 3dly, If the Errors had been the one too big, and the other too little, reſpect being had to the fifth Rule foregoing, the Anſwer would have been the ſame; as thus, I take for my firſt poſition 6, and then the Error is 32 too little, then I take for my ſecond Poſition 18; and then the Error is 16 too much, then I multiply the Poſitions and Errors croſs-wiſe, and the Products are 96 and 576, and becauſe the Errors are unlike, *viz.* one too big, and another too little, I add the Products 96 and 576 together, and their Sum is 672 for a Dividend; I likewiſe add the Errors 32 and 16 together, and their Sum is 48 for a Diviſor, then having finiſh'd



Diviſion, I find the *Quotient* to be 14, which is the Anſwer as was found out at the 2 ſeveral Trials before.

For Proof of the Work, I ſay,

l.
If A *paid*————————————14
Then B *paid* 14 *and* 10 (*that is*)—24
Then C *paid* 14 *and* 24 (*that is*)—38

The Sum of all is—— 76

which is the Total Value of the Building, and equal to the given Number.

Thoſe who deſire to ſee the *Demonſtration* of this Rule, let them read the 7th Chapter of Mr. *Kerſey*'s Appendix to Mr. *Wingate*'s Arithmetick, *Petiſcus* in the 5th Book of his *Trigonometria*, or Mr. *Oughtred* in his *Clavis Mathematica.*

Queſt. 2. Three Perſons, A, B, and C, thus diſcourſed together concerning their Age; quoth A, I am 18 Years of Age; quoth B, I am as Old as A and half C; and quoth C, I am as Old as you both, if your Years were added together. Now I deſire to know the Age of each perſon? *Anſwer*, A is 18, B is 54, and C is 72 Years of Age.

Queſt. 3. A Father lying at the point of Death, left to his three Sons, *viz.* A, B, C, all his Eſtate in Money, and divideth it as followeth, *viz.* to A he gave half wanting 44*l.* to B he gave 1-3d and 14*l.* over, and to C he gave the Remainder, which was 82*l.* leſs than the Share of B, now I demand what was the Sum left, and each Man's part? *Anſwer*, The Sum bequeathed was 588*l.* whereof A had 250*l.* B had 210*l.* and C had 128*l.*

Queſt. 4. Two perſons, *viz.* A and B had each in their Hands a certain number of *Crowns*, and A ſaid to B, If you give me one of your *Crowns*, I ſhall have five times as many as you; and ſaid B to him again, if you give me one of yours, then we ſhall each of us have an equal Number; now I demand how many *Crowns* had each perſon? *Anſwer*, A had 4, and B had 2 *Crowns.*

Queſt. 5. What Number is that unto which if I add 1-4th of itſelf, and from the Sum ſubtract 1-8th of itſelf, the Remainder will be 210? *Anſwer*, 192.

Many more *Queſtions* may be added, but theſe well *underſtood*, will be ſufficient, (even for the meaneſt Capacity) for the *Reſolution* of any other *Queſtion* pertinent to this Rule.

There may be an *Objection* made becauſe we have not treated particularly upon Intereſt and Rebate; but the *Operation* of ſuch *Queſtions* being more applicable to Decimals, are omitted, till we come to acquaint the Learner therewith.

LAUS DEO SOLI.

FINIS.

Advertiſement.

THere is lately brought from Chili, a Province in America, a moſt excellent Natural Balſam, far exceeding that of Peru and Tolu, in curing moſt Diſeaſes in human Bodies; as it hath given Demonſtration: 'Tis a Remedy no Man under the Sun can compoſe, as being a moſt Odoriferous and Natural Balſam. It cures all Pains proceeding from Cold, corroborates the Stomach, creates an Appetite, and ſtrengthens the whole Body: It is a wonderful Remedy for all internal Sores, Bruiſes, Ulcers, &c. and mightily helps all Aſthmatical Diſtempers: 'Tis alſo a great Cephalick, helping moſt Diſeaſes of the Head, and ſtrengthning the Brain and Nerves: It kills the Worms, provokes Urine, and is good againſt the Stone; helps all Fluxes of the Belly; is excellent in all Diſeaſes of the Ears, eſpecially Deafneſs: It alſo cures all manner of green Wounds, and many other Diſtempers, which may be ſeen at large in the printed Bills of Directions.

And whereas this Excellent Balſam, ſo well known, and advertiſed in ſo many thouſands of Books, and ſold ſo many Years at this place, and has deſervedly met with Incouragement from the publick, which has tempted a certain Empirick or Quack-Doctor, who conſequently is ignorant of the matter, to impoſe a Counterfeit ſort on the World, of his own preparing, and has prevailed with ſome perſons to ſell it, and ſeveral unwary perſons have been impoſed on thereby, and have hereby complained, that it was not ſo good as it uſed to be; when on ſearch into the matter, it has been found to be the above-mentioned Sham. So all perſons who have occaſion to ſend, are deſired to give ſtrict Orders to enquire for the Name *TRACY*; for elſe the moſt cautious, who do not know the Houſe, may be impoſed on: It is only to be had of H. Tracy, at the Three Bibles on London-Bridge, at 1 s. 6 d. the Bottle, with Allowance to thoſe who ſell it again.

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